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DEPARTMENT OF DEFENSE AUTHORIZATION FOR APPROPRIATIONS FOR FISCAL YEARS 1990 AND 1991

HEARINGS

BEFORE THE

COMMITTEE ON ARMED SERVICES
UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

FIRST SESSION

ON

S. 1085

AUTHORIZING APPROPRIATIONS FOR FISCAL YEARS 1990 AND 1991 FOR MILITARY ACTIVITIES OF THE DEPARTMENT OF DEFENSE, FOR MILITARY CONSTRUCTION, AND FOR DEFENSE ACTIVITIES OF THE DEPARTMENT OF ENERGY, TO PRESCRIBE PERSONNEL STRENGTHS FOR SUCH FISCAL YEARS FOR THE ARMED FORCES, AND FOR OTHER PURPOSES

PART 2

DOE DEFENSE PROGRAMS
BALANCED TECHNOLOGY INITIATIVE
DOD UNIVERSITY RESEARCH PROGRAM
ICBM MODERNIZATION

MAY 17; JUNE 14, 20, 21, 1989

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DEPARTMENT OF DEFENSE AUTHORIZATION FOR APPROPRIATIONS FOR FISCAL YEARS 1990 AND 1991

WEDNESDAY, MAY 17, 1989

U.S. SENATE,
COMMITTEE ON ARMED SERVICES,
Washington, DC.

DEPARTMENT OF ENERGY DEFENSE PROGRAMS

The committee met in open session, pursuant to notice, at 2 p.m. in room SR–222, Russell Senate Office Building, Senator J. James Exon presiding.

Committee members present: Senators Nunn (chairman) Exon, Levin, Bingaman, Dixon, Glenn, Gore, Wirth, Warner, Thurmond, Cohen, Gorton, and Lott.

Committee staff members present: Arnold L. Punaro, staff director, Andrew S. Effron, general counsel, and Marie Fabrizio Dickinson, assistant chief clerk.

Professional staff members present: Sherri W. Goodman, William E. Hoehn, Jr., David S. Lyles, and Michael J. McCord.

Minority staff members present: Patrick A. Tucker, minority staff director and counsel; Robert F. Bott, George K. Johnson, Jr., and George W. Lauffer, professional staff members.

Staff assistants present: Lisa B. Hastey, Cindy Pearson, and Debra A. Rice.

Committee members' assistants present: Jeffrey B. Subko, assistant to Senator Exon; Edward M. McGaffigan, Jr., assistant to Senator Bingaman; Milton D. Beach, assistant to Senator Glenn; Leon S. Fuerth, assistant to Senator Gore; Jefferson B. Seabright, assistant to Senator Wirth; Terrence M. Lynch, assistant to Senator Shelby; James M. Bodner, assistant to Senator Cohen; Dudley L. Carlson, assistant to Senator Wilson; Anthony H. Cordesman, assistant to Senator McCain; Robert M. Soofer, assistant to Senator Gorton; and Charles G. Pearcy, assistant to Senator Lott.

OPENING STATEMENT OF SENATOR J. JAMES EXON, PRESIDING

Senator EXON. The committee will please come to order. We are very pleased to have Adm. James D. Watkins, the Secretary of Energy, with us today. He is a man who needs no introduction to the members of our committee. I am delighted that Admiral Watkins has taken this especially tough post at such a critical time.

This afternoon the committee continues its work on addressing the problems of the Nation's nuclear weapons complex. By now these problems are well known and need little recounting. The facilities are old and need to be modernized. The safety standard is outdated and needs to reflect current practices. The environment has been contaminated, and it must be cleaned up.

At this Senator's initiative, Congress increased the Department of Defense environmental restoration budget by over 40 percent last year. I am pleased that the Bush administration has requested substantial increases in this account for fiscal year 1990.

I believe, Admiral Watkins, that this committee would look favorably on identification of additional cleanup needs that can be funded in fiscal year 1990. I urge you to come forward with your proposal in this area as soon as possible.

Last year as part of the Defense Authorization Act, Congress created the Defense Nuclear Facilities Safety Board to make recommendations to the Secretary of Energy on safety at the Department of Energy's defense facilities. The deadline for submitting to the Senate nominations to this five-member board occurred in March. This board will be critical both to restart the Savannah River reactors and to the construction of new facilities. Admiral Watkins, I hope that you will convey to the President my personal dismay that nominees to this board have not yet been received by the Senate. I think we need to get cracking.

Today I would like to suggest several proposals for the Department of Energy defense programs that I intend to offer for the committee's consideration as part of the defense authorization bill.

First, I believe one of the most pressing needs for the Department of Energy today is for a coordinated approach to the development and advancement of the technologies in environmental cleanup. To date, little of the enormous tactical talent that exists at the Department of Energy's laboratories has been applied to advancing the technologies that will be needed for environmental cleanup throughout the nuclear weapons complex. New technologies offer the possibility of accelerating cleanup schedules and perhaps reducing long-term cost. The Department of Energy has many laboratories, from Argonne to Brookhaven, from Los Alamos to Livermore, that have much to offer.

A coordinated program devoted to advancing the state of the art in cleanup technologies is urgently needed. I will recommend the authorization of a Cleanup Action Program, or CAP, as part of the defense authorization bill. CAP is needed to apply the technical talent of the Department of Defense's national weapons labs and at universities to the cleanup problem. CAP is needed to ensure a sustained level of funding with a long-term cleanup effort. CAP is needed to provide the Department of Energy with the congressional support it needs to undertake this massive multi-year cleanup effort. I hope that my colleagues will support this initiative.

Second, Congress has already addressed the safety problems at the nuclear weapons complexes by creating the Defense Nuclear Facilities Safety Board last year. Defense waste and environmental cleanup pose a much longer-term, more intractable problem. Admiral Watkins, you have already announced your intention to prepare a 5-year plan for defense waste cleanup. This is the first peace of the cleanup pie, and I congratulate you for it.

Another piece, as I have just proposed, is CAP, a Cleanup Action Program to provide the technological wherewithal to address the problems laid out in the 5-year plan.

There is still one more piece of the pie missing, a long-term funding plan. I believe we need to marshal the advice of the independent experts on the impact and the important matter as far as the public policy and the problems that confronts on how we efficiently and equitably manage to fund the Department of Energy's multiyear cleanup problem at the rate of several billion dollars a year. I am sure as you have indicated previously, Mr. Secretary, it is going to be at least that. No scientific or analytical framework currently exists for such a long-term cleanup problem.

The Superfund model, while attempting to address somewhat similar problems, is distinctly different because it is able to adapt private industry as a major source of revenue. The Department of Energy's defense facilities are all owned by the Federal Government. As such, they present a unique, a very difficult, and a very different case. The Department of Energy needs an independent commission composed of wise men and women to review and assess its long-term plans for cleanup and to recommend an alternative to funding approaches. Admiral Watkins, I am not talking about a group of individuals that would attempt to duplicate your efforts or add more layers of oversight. This is distinctly not the case. I am talking about an independent commission to help Congress with the intractable problem of developing a funding strategy for the long-term cleanup program that you are now involved in, and I want to compliment you on the job that you have done so far in defining this.

Third, the Department of Energy needs to provide a better accounting of the money that it spends today on cleanup activities. To understand the Department of Energy's cleanup budget today, one must know, for example, that environmental restoration is only one part of the Department's overall cleanup budget and that most of the money it spends to bring Department of Energy facilities into compliance with environmental laws is hidden in various parts of the Department's budget. We have an obligation to American taxpayers to display more clearly the ways in which their money is being spent.

Admiral Watkins, I look forward to working with you to reform the present situation and the presentation of the Department of Energy's cleanup budget. We are going to work in consort on this. Admiral Watkins, I cannot think of anyone more suited than you to the challenges of revitalizing the nuclear weapons complex, and revitalizing is certainly what it needs. In your first 2 months you have already begun to make tremendous waves and to instill into the Department enthusiasm and vitality that it has not seen in some time. This is one Senator who hopes that you will continue to rock the boat, because that is obviously necessary, and I pledge the cooperation of this committee in your activities.

Are there any opening statements? Senator Thurmond.

Senator THURMOND. Mr. Chairman, thank you very much. Admiral Watkins, we are delighted to have you with us, and we are glad to have your fine aides here, too.

Thank you, Mr. Chairman, and thanks to Senator Warner for his courtesy. I would like to associate myself with your remarks, Mr. Chairman, and join you in welcoming our distinguished witness this afternoon. Admiral Watkins is no stranger to this committee. He comes to the Department of Energy at a critical time in its history. The challenges facing the Department and especially those facing the nuclear weapons production complex demand the intelligence, leadership, and the vision that Admiral Watkins brings to the job. I congratulate you on your appointment, Mr. Secretary, again, and I thank you for your continued dedication to the service of our country and look forward to working with you.

Senator Nunn and I have already witnessed firsthand the style of leadership that Admiral Watkins brings to the Department. We had the privilege of visiting the Savannah River site together with him as he toured the facilities and spoke with the workers there. The Admiral shares, as we do, the vital importance of restarting the Savannah River reactors in a safe, environmentally sound, and timely manner. I, too, am delighted that the Admiral has chosen Savannah River to become the flagship of the revitalized nuclear weapons complex. Based on my discussions with the Admiral and the personnel and the other actions he has already recommended, I believe we are going to be making some real progress toward assuring a safe and reliable supply of tritium until a new production reactor capacity is ready.

We need not remind the Secretary that as important as the restart of the Savannah River reactors is to our national security, the challenges facing defense programs go well beyond reactor restart. In a budget environment for the national defense function, there is already required hard choices and program cancellations. We face the monumental task of modernizing the production complex, cleaning up the environmental legacy of an era when there was less sensitivity to waste management, and maintaining a modern and effective nuclear stockpile. We all realized that there would be tough tradeoffs, but we also recognize that as a nation we can ill afford not to take decisive action in each of these areas.

It is with that in mind, Mr. Chairman, that I applaud your call for a 5-year planning process for this problem of energy weapons programs. The Admiral's testimony today indicates that he has already begun such a planning process in the modernization and waste management areas, and we support his initiative.

We have heard recent testimony about the Department of Defense planning process that was sobering. The lesson of experience is that we must be realistic in our expectations to future funding. The challenges that the Department faces are all long-term projects. None will be solved in a year or two years, so it is particularly important that we be able to rationalize our funding allocation each year against a long-range plan that balances operations, modernization, and cleanup priorities.

Mr. Chairman, I also join you in endorsing the Secretary's call for applying technology to the task of environmental cleanup and waste management. All of us have been overwhelmed by the cost estimates of cleanup that have been provided to date. If we can lower those estimates by high leverage technology investment up front, both defense programs and the Nation will be the beneficiary.

Finally, Mr. Chairman, I want to remind the Secretary of the strong support he enjoys in this committee for the new production reactor capacity. Under the leadership of Chairman Exon, the Strategic Subcommittee has developed an extensive record on the urgency of this project. I note that the Secretary to date has strongly supported the concept of duality, and I support that concept as well. Our national security interest should not be jeopardized by the failure of a single node in the total weapons complex. On the other hand, Chairman Exon has reminded us many times of the budget situation and the need to prioritize. I continue to believe that for a new production reactor, the Savannah River site offers the infrastructure and local support that are necessary to bring a new reactor on line as soon as possible.

Mr. Chairman, I will have some questions for the Admiral a little bit later. I thank you very much.

Senator EXON. Thank you, Senator Thurmond. Senator Nunn.

Chairman NUNN. Thank you very much, Senator Exon and Senator Thurmond. Senator Exon, I appreciate your taking the chair today. This is a full committee hearing, but I will be in and out for the first half hour or so, and I appreciate your presiding. I would also like to commend you and Senator Thurmond for the leadership that both of you have given to Department of Energy matters in the Strategic Subcommittee.

The Strategic Subcommittee has now held 15 hearings on Department of Energy matters over the last 2 years and enacted the Defense Nuclear Facilities Safety Board as part of last year's authorization bill. This year you have already chaired numerous hearings on the Department of Energy, so I commend both of you for your leadership.

The committee is pleased to welcome Admiral Watkins here today in his first appearance before the Senate Armed Services Committee as the Secretary of Energy. Admiral Watkins is, however, on familiar terrain, having testified many times before this committee in his naval career. Admiral Watkins is at the helm of the Department of Energy at a time when it faces many challenges.

First, most of the Department of Energy's facilities are approaching the end of their useful life and will need to be modernized or replaced.

Second, modern safety management principles must be adopted.

Third, the Department of Energy needs to clean up waste and environmental contamination.

I am personally delighted, Admiral Watkins, to see how quickly and how forcefully you have moved to focus the Department's energies on these very pressing problems. In this regard, I am especially pleased that you have chosen to concentrate your early efforts on putting together a plan for the safe restart of the Savannah River reactors. I strongly support your commitment to make safety the co-equal of production. I think that is exactly what needed to be said, and you said it in a very forceful way. You selected Savannah River as the flagship of a revitalized nuclear weapons complex, and I appreciate the firsthand look that you offered to me and to

Senators Thurmond and Glenn when we went down there several weeks ago.

Perhaps the most daunting challenge that you face, Mr. Secretary, is putting all of the Department pieces together—safety, modernization, and cleanup—in a long-range, fiscally realistic plan that will provide the basis for revitalizing the nuclear weapons complex.

I intend to propose for the committee's consideration as part of the authorization bill a requirement that the Department of Energy submit a 5-year plan for all of its defense programs including modernization and cleanup on an annual basis just as the Department of Defense does today. You have already initiated the development of a 5-year plan for the management of cleanup programs, and we welcome that. This effort could be expanded, as I view it, and formalized to include all of the Department of Energy's defense programs.

While the 2010 Report provided cumulative funding levels for modernization and cleanup over 20 years, it failed to indicate how we get there from here on an annual basis. That is a real challenge. We need a clearly articulated 5-year plan for all Department of Energy defense programs that includes annual funding profiles. It is my hope that, if we can pass this and if you agree, this would provide the stability and the roadmap we need to revitalize the nuclear weapons complex during an era of budgetary contraction and great uncertainty.

So we thank you for being here today. Senator Exon, if you would remain in the chair, I will be coming in and out for the next few minutes, and then I will be here for the remainder of the day. Thank you.

Senator Exon. Thank you, Mr. Chairman. Are there any other opening statements? Senator Glenn.

Senator Glenn. I would ask that my entire statement be included in the record as I will summarize it very rapidly.

Senator Exon. Without objection.

Senator Glenn. All of us have been glad, Admiral Watkins, to see the way you have taken over very forcefully, expeditiously, quickly, decisively, and in a spirit of cooperation. There are just three things I wanted to mention.

First, the restart of the reactors down there. I understand that Westinghouse has proposed to forego the ultrasonic testing. GAO, in their look at that whole thing in 1987, recommended strongly that that be done. I think we have spent some $20 million, as I understand it, on ultrasonic equipment with Westinghouse. I do not know whether you are balking, are using it, or whether you have made a final decision on that. I think using that equipment before startup might do a great deal to assure the public that we are doing everything that can possibly be done.

Second, as you establish a 5-year plan, I would like you to reconsider the OSHA exemption that the Department of Energy has had for all these years. I think the training and safety that we apply to every other government entity should apply to Department of Energy nuclear plants. I think we are to the point now where the complex is no longer necessarily under quite the secrecy arrangements as it once was. I think that the health practices that GAO has discovered are well behind those of the private sector, and I would hope they could now be brought up to speed and that letting OSHA in to give advice on that as they do on very other government facility would be in order.

And third, in developing a long-term plan for the Department of Energy site cleanup, I would hope that we would go ahead with what we know we can do right away without waiting for the whole picture to come into focus. I plan to seek additional funding for the environmental cleanup in the fiscal year 1990 budget. There are some projects that the Environmental Protection Agency has identified which could be funded now.

For example, according to the Environmental Protection Agency's A106 Report to the Office of Management and Budget, there are 46 Department of Energy pollution abatement projects that are in violation of existing standards and for which the Department has not asked for funding in fiscal year 1990. So you may want to address that. I applaud you for the start you have been making and look forward to working with you.

[The prepared statement of Senator Glenn follows:]

PREPARED STATEMENT OF SENATOR JOHN GLENN

I would like to welcome Admiral Watkins on his first appearance before this committee. I also want to express my appreciation for his initial efforts to deal with the difficult challenges of modernizing and cleaning up our Nation's nuclear weapons production complex. Having spent the better part of a decade dealing with DOE's environmental, safety, and health problems, it is gratifying to see Admiral Watkins take charge quickly and decisively.

In the spirit of cooperation, I would like to bring up some potentially serious problems affecting DOE's modernization and environmental cleanup efforts. First, there is the matter of the restart of the reactors at the Savannah River plant. I understand that the Westinghouse Corporation has proposed to forego ultrasonic testing of SRP's reactor vessels until the reactors are restarted.

In 1987 the General Accounting Office recommended to the Governmental Affairs Committee, which I chair, that ultrasonic testing be done on the SRP reactors. Now after some $20 million has been spent on special ultrasonic equipment, Westinghouse is balking at using it. The Westinghouse proposal does little to restore public confidence in the SRP reactor process. I hope that DOE will see fit to perform these essential tests before the reactors are restarted.

Second, as DOE establishes its 5-year plan for environmental cleanup, I am concerned that current and future workers be afforded adequate training and safety protection. The GAO has reported that DOE occupational safety and health practices are behind those of the private sector. Environmental cleanup of DOE sites could prove to be among the most dangerous jobs in the nuclear industry. Thus, we must assure that DOE contract and subcontract employees are provided the best available forms of training and protection.

Finally, I believe that while we need to develop a careful long-term plan for DOE site cleanup, we also don't have the luxury of waiting before we take action. In this regard, I plan to seek additional funding for environmental cleanup at DOE sites for fiscal year 1990. There are several cleanup projects that the Environmental Protection Agency and the States have identified which could be funded now. For example, according to EPA's A-106 Report to the Office of Management and Budget, there are 46 DOE pollution abatement projects that are in violation of existing standards for which DOE has not asked funding for in fiscal year 1990.

Nonetheless, I commend Admiral Watkins for his initial efforts and hope that I can work with him over the coming years.

Senator EXON. Thank you, Senator Glenn.

Senator Dixon has asked that his prepared statement be made a part of the record.

[The prepared statement of Senator Dixon follows:]

PREPARED STATEMENT OF SENATOR ALAN J. DIXON

I am pleased to welcome the Secretary of the Department of Energy, Admiral James D. Watkins, as he appears before this committee to testify on defense-related authorization requests for fiscal years 1990 and 1991.

We are faced with several serious challenges regarding our nuclear weapons complex. We need to guarantee that we will have a reliable complex in the future and we need to ensure that this complex poses no threats to workers or to the public. We must also clean up our environment and effectively manage our nuclear waste now so that an extensive—and expensive—nuclear cleanup is not needed in the future.

Mr. Watkins' opening statement highlights several problems confronting his Department that I am worried about. The Secretary points out that we have outdated facilities, that we are no longer the "front runner" in many key technologies, and that we are losing our competitiveness. The Secretary further states that "too many critical components are being designed and manufactured offshore, and foreign ownership of our industries is jeopardizing our ability to develop or commercialize new technology."

I share Mr. Watkins' view that we are less competitive and losing industries to foreign ownership. To help stem the tide I will soon be introducing amendments to the Defense Production Act of 1989 that will increase production capabilities, increase competitiveness, and encourage investment in the defense industrial and technology base.

The Department of Energy and this committee have serious challenges before us concerning this Nation's nuclear weapons complex. We are also facing a revenue shortage that will not allow us to fund all the programs that we need. Mr. Watkins' testimony here today will help this committee prioritize our spending requirements. I look forward to his comments.

Mr. EXON. Without objection, we will accept in its entirety the statement prepared for this meeting by Admiral Watkins, and we recognize you for summation or comments or to proceed in any fashion that you wish at this time. Welcome, Admiral Watkins.

STATEMENT OF HON. JAMES D. WATKINS, SECRETARY OF ENERGY, DEPARTMENT OF ENERGY, ACCOMPANIED BY TROY E. WADE, ACTING ASSISTANT SECRETARY FOR DEFENSE PROGRAMS; AND LEO P. DUFFY, SPECIAL ASSISTANT TO THE SECRETARY FOR DEFENSE WASTE MANAGEMENT, ENVIRONMENTAL RESTORATION AND COORDINATION OF DOE WASTE MANAGEMENT

Secretary WATKINS. Thank you very much, Mr. Chairman and members of the committee. I appreciate again the opportunity to appear before this particular committee and discuss the role of the Department of Energy in preserving and advancing our Nation's interest in having and in helping to maintain our national defense.

I will say before proceeding with my brief oral remarks that I am very much in sympathy with the comments made by all members today in their opening remarks. I am very much aligned with those feelings, and I feel as a result of that, that working with this committee and other similar committees in Congress, we are going to make significant progress in the next year in getting a baseline of understanding of what we must do. We will be well on the way a year from now and, I think, be pleased that we finally have our arms around a very complex problem.

I can talk about the individual points that you raised in questions and answers, and I will proceed with my brief oral comments.

One of the Department's primary missions is to manage and operate the country's nuclear weapons complex which provides the materials necessary to maintain our nuclear deterrent. The Department of Energy is also responsible for developing policies and strategies that preserve and enhance our Nation's energy security, a vital component of national security.

Through its national laboratories, the Department plays a key role in fostering America's scientific and technological leadership. It is said that we house two-thirds of the intellectual talent of the country within our laboratories. Our laboratories are a world renowned source of technology for both defense and nondefense scientific endeavors.

The nuclear weapons requirements that drive the entire Department of Energy defense complex are, as you know, generated by our Nation's weapons stockpile memorandum approved by the President. The Department of Energy has a responsibility to ensure that it can meet these requirements that are contained in the presidential memorandum. Today's nuclear weapons complex is basically a "single track" system that lacks the necessary redundancy in certain critical areas.

We do have flexibility in some areas, but there are choke points today that could bring the complex to a halt. This situation is unacceptable from a national security standpoint. The President's budget request in fiscal year 1990, therefore, reflects the need to develop contingency capability for the future. The most compelling example of what I am talking about is that new production of tritium and plutonium is essentially impossible within this country as long as the three Savannah River production reactors remain out of service.

The Soviets have about 11. We have none today. In order to have the flexibility we need for future contingencies, we need to design and construct two new production reactors to assure an adequate capability to supply tritium, and we need to construct a special isotope separation plant to upgrade our plutonium reprocessing capabilities and technologies to assure that we can meet potential additional requirements for plutonium if called upon.

I view the problems confronting Savannah River as endemic throughout the nuclear weapons complex. Difficulties experienced at one site inevitably affect other parts of our integrated complex. I believe this point was well made during the recent visit hosted by Senator Thurmond that Senator Nunn and other colleagues here on this committee and I made to Savannah River. In that connection I am attaching to this statement a copy of my letter to the chairman and to other members of this committee regarding my initial assessment of the restart of the Savannah River production reactors. As an aside, I would like to state my appreciation for the time taken by the chairman and others on the committee, to accompany me on a very long but productive day at Savannah River.

Now within my formal statement for the record today and in my letter of April 27 to the committee, there is one issue that I would like to discuss, and that is WIPP, the Waste Isolation Pilot Plant. The Waste Isolation Pilot Plant is now becoming the long pole in the tent of moving waste responsibly throughout the Nation, and it is the key to unlocking the movement of waste in such a way that production, safety, and waste management are all now co-equals.

I would like to talk a little bit about that. It is another example of the interrelated nature of the Department's nuclear weapons complex. Failure to open the WIPP facility as originally scheduled, which was August of last year, has given us some additional complications in waste movement. We had hoped to be able to start it in August. We met only yesterday for the first time after a series of intense meetings with the Environmental Protection Agency on what is called a no-migration petition. This is essential for starting up the WIPP facility.

It is ironic that since WIPP was started 8 years ago, this no-migration petition process which applies to toxic waste, not to radioactive waste, was passed into law subsequently and, therefore, we are caught up in it and now are at the 11th hour, and it becomes a very difficult, complex task that is before us that will preclude an opening on September 1 as we had planned.

We only learned that yesterday, but I think rather than letting you know tomorrow by letter, it is better to air this today and get it out in the open. We have informed the various members of the New Mexico delegation just today and the various Governors of the States to alert them so if they hear about this particular hearing, and on this issue, they do not get too upset because we believe we have the situation under a variety of controls that we can manage.

For example, we believe we will have all the information available by November 1989 with a very hard court press put on by both the Department of Energy and the Environmental Protection Agency, and we believe we can meet that schedule. That does not permit all the necessary hearings that will not be completed until February.

We have looked at what we have done on waste minimization at Rocky Flats, which is connected with this because of the flow to Idaho and from there to WIPP. We believe that that waste minimization, program will cut down the volume of anticipated waste to manageable levels through February. So we believe that at least one element of that equation can be satisfied by that waste minimization program.

We also have the ability during the research and development program, which I think needs to be recognized as a unique feature of this particular waste migration petition, to extract any waste at any time that we feel that migration, which usually is a very long-term geological fluid migration is a problem. These are the kinds of things we would hope to be able to work out with this committee and other committees on the Hill to make sure we all understand where we are going as of November.

Certainly, I believe that if we can manage the waste in the interim and not exceed the limits in the State of Colorado at Rocky Flats, and if we can satisfy Governor Andrus in Idaho, that we can live with this long pole in the tent that I mentioned. So to that extent I wanted to explain that now rather than have it be misunderstood perhaps by all of the Governors very legitimately concerned about this very important part of the waste movement process.

The nuclear weapons program has been through many cycles in its 40-year history. Over time, the trend has been to correlate closely facilities and capabilities with specific stockpile demands. As the stockpile has declined from peak level, so too have our facilities and capabilities. We simply have not provided the resources needed to maintain the sizable investment in these strategic facilities, and now we have to pay the piper.

I am aggressively addressing both near- and long-term problems. We must modernize the nuclear weapons complex, dispose of our waste, and clean up and protect the environment so that we safeguard our workers and the public and do not jeopardize our ability to meet strategic responsibilities.

I want to iterate, Mr. Chairman, that the national security is too important to trust to a single track strategy of weapons facilities. The modernization study released by my predecessor presented a number of options available for assuring a long-term viability of the nuclear weapons complex. Let me emphasize at this point that I am no more comfortable with the high cost of modernization as estimated in that study than I was with their estimates on the cost of cleanup. As a consequence, I have directed the development of my own 5-year modernization plan in order to review the assumptions of the previous study and to establish a more fiscally responsible context for modernization.

No one wants to repeat the mistakes of the past, neither you nor I. I think you will agree that sufficient flexibility and duality is a necessary principle to permit us to meet potential contingencies, just as improved capabilities are necessary to avoid obsolescence.

I intend to show this committee that the Department is turning itself around. The initiative under way to restore operation to Savannah River will achieve results. Progress in upgrading other facilities will follow. This will take time, and by the end of the summer you should begin to see the kind of progress that I promise. As always, this committee will be kept fully informed of our progress, and your assistance is absolutely essential if we are to be successful.

Now what assistance do I need from this committee at this juncture in the fiscal year 1990 authorization process? You, Mr. Chairman, offered several points where you felt we could be assisted, and I agree with those. Here are some additional ones. These are in addition, obviously, to the President's budget request of February 9, so this has not heretofore been mentioned.

I need authorization language that will allow me to establish new lines of authority at management levels in both headquarters and the field activities so as to fix accountability and responsibility for waste management, environment, safety, security, and health programs within the Department of Energy's line management and not just within its internal oversight mechanisms. I think this is a concept that very few recognize.

The line must have the responsibility for these things; otherwise, the oversight committees have nothing to oversee except what is actually being done by the contractors which the Department has no knowledge of on a day-to-day basis. So we must have our own oversight within the line as we do in all our Department of Energy complex and where we run things in a professional fashion. We simply do not have it today.

This is very important. It is the most critical variable in my equation right now. While I do not need any monies for that, I do not want to surprise this committee when you see me make a move within the next 2 days of setting up line management accountability and responsibility within the defense programs of the Department of Energy complex. This means both at headquarters and at Savannah River, but it will be equally applicable over time to all of my facilities. In the future when you ask me if I am carrying out my responsibilities, I can in fact tell you in some detail on a day-to-day basis and perhaps preclude the kind of after-the-fact surprises that have been almost commonplace with the Department of Energy.

So as I say, today no such concept of line accountability exists and, as a result, contractors execute their contracts without adequate day-to-day line oversight by the Department of Energy.

Second, I want to work with you to create a comprehensive epidemiological data repository within the Department of Energy with responsibility for long-term collection and dissemination of epidemiological data related to our facilities. This is extremely important because it is one item that has not been addressed at all by the Department of Energy in any professional fashion, and it is critical to the line management accountability for health. We simply do not know where we stand today. On too many issues we do not have the epidemiological data base, and we desperately need it. We know how to do that, and I will be talking about that in more depth if you have questions about it, but certainly we are ready to do that.

My problem is in the long term. I know what to do in the near term, and we are ready to move. I will talk about that a little later.

The Department, then, is in a critical period of rejuvenation. With your help we can initiate environmental restoration of the weapons complex, enhance scientific development through support for education and technical training, and do our part to help our country regain technological leadership in the world community.

In this regard I would say, Mr. Chairman, that it is not only in waste management where future technologies are critical to the proper management of our waste in a cost effective way, but it is also equally applicable to many areas of technology that we are losing out on worldwide. There is no reason not to apply our best intellectual talent in this country to focus on selected areas in a more institutionalized process way so that we can get this Nation on its feet competitively before everyone else beats us in commercializing our basic research, which usually gives the world some of their first ideas to production and sale. Then we can commercialize such things as ceramics and that sort of thing that we are losing out on now. There is no reason not to take the applicable technologies out of our laboratories and in a very positive program way bring these things to transition to commercialization in a selected number of areas without overwhelming our traditional role in building the new weapons materials and the weapons themselves that we need for national deterrence.

I think we need to take a two-pronged approach. Waste management is one of the technological areas, but there are several others that are critical to the Nation, and we are not doing well in them today and I think we can do a lot better.

Again, I thank you for this opportunity to testify, and I want to personally thank members of the committee for the support they have given me over the last few months to get started. I am pleased to say that a good working relationship with the Senate Armed Services Committee is not a new one to me, and I have been delighted to find my old friendships strengthened as I assume this new role. Thank you, Mr. Chairman.

[The prepared statement of Secretary Watkins follows:]

STATEMENT OF
ADMIRAL JAMES D. WATKINS
SECRETARY OF ENERGY

Mr. Chairman and Members of the Committee, I appreciate the opportunity to appear before you today to discuss my views regarding the role of the Department of Energy (DOE) in preserving and advancing our Nation's interests in having a safe, clean, and economically viable supply of energy, and in helping to maintain our national defense.

One of the Department's primary missions is to manage and operate this country's nuclear weapons complex, which provides the materials necessary to maintain our nuclear deterrent. DOE is also responsible for developing policies and strategies that preserve and enhance our Nation's energy security -- a vital component of national security. Through its national laboratories, the Department plays a key role in fostering America's scientific and technological leadership. Our laboratories are a world renowned source of technology for both defense and nondefense scientific endeavors.

Since being nominated by the President to serve as Secretary of Energy, I have had the opportunity to study closely the programs, policies, and strategies of this Department, and the manner in which they relate to other agencies and branches of government. I am struck by one basic observation that, over the years, the strategic context of this Department has been ignored. I am convinced that this has contributed in large part to the cultural malaise and serious problems that now plague some of our vital DOE facilities.

The nuclear weapons requirements that drive the entire DOE defense complex are, as you know, generated by our Nation's defense needs and are contained in the annual Nuclear Weapons Stockpile Memorandum approved by the President. DOE must ensure that it can meet requirements contained in this Presidential memorandum. Today's nuclear weapons complex is basically a "single track" system that lacks needed duality or redundancy in key critical areas. We do have flexibility in some areas, but "choke points" that exist today in critical areas can bring the complex to a halt. This situation is unacceptable from a national security standpoint and the President's budget request for FY 1990 reflects the need to develop needed duality for the future.

I believe the most compelling example of this problem is that new production of tritium or plutonium is essentially impossible within this country as long as the three Savannah River production reactors remain out of service.

In order to allow ourselves needed flexibility for the future, we need to design and construct two new production reactors for assured tritium supply capability, as well as upgrade our plutonium reprocessing capabilities and technologies and assure that we can meet potential contingencies by constructing the Special Isotope Separation (SIS) Plant.

The budget request now before Congress includes those items, and others, to increase this essential flexibility. In the interim, we cannot afford to shut off any of our options. We are still considering future N Reactor operations, conversion of WNP-1, and other activities to assure nuclear material supply. Protection of these contingencies is necessary until we have a much clearer picture than we have today of our Savannah River production reactor prospectus. I expect to have a first solid look at this prospectus by July 1989.

Equally important is the realization that environmental, public health and safety issues are important components of the Department's strategic responsibility to produce nuclear warheads and treat or dispose of the wastes that have been generated over 40 years of nuclear operations. In mid-March, I initiated the preparation of a 5-year environmental and waste cleanup plan. I envision this 5-year planning initiative to be the cornerstone of our efforts to "institutionalize" environmental restoration and waste cleanup activities within DOE from this point forward. I consider this to be an exciting new opportunity and a long overdue change in policy. Waste operations and environmental protection must be on par with production. Through this work, I hope to reestablish public confidence in our ability to operate these facilities safely and without posing an unacceptable threat to public and worker health.

Moreover, I view the problems associated with the Savannah River complex as being endemic with other parts of the nuclear weapons complex. Difficulties experienced in one aspect of the complex will ultimately affect another part of an integrated complex. I believe this point was well made during our recent visit to the Savannah River site hosted by Senator Thurmond. Along these same lines, I have attached to this statement a copy of my April 27 letter to you, Mr. Chairman, regarding my initial assessment of the restart of the Savannah River production reactors. I want to say I deeply appreciated the time taken by the Chairman, Senator Thurmond, and Senator Glenn, to tour the Savannah River plant with me on April 28.

Problems associated with opening the Waste Isolation Pilot Plant (WIPP) in New Mexico are another example of the interrelated nature of the Department's nuclear weapons complex. Failure to open the WIPP facility as originally scheduled required that DOE stop radioactive waste shipments from its Rocky Flats Plant to Idaho, where additional waste was being temporarily stored. The backlog of waste materials that had to be stored at Rocky Flats soon began to jeopardize the operation of the entire facility. We were able to temporarily resolve this issue with the help and understanding of Colorado and Idaho officials pending the scheduled opening of the WIPP facility in September. We still face technical and institutional impediments to opening the WIPP facility, including the need to finalize the safety analysis, review and approval of a no-migration petition by the Environmental Protection Agency, and publication of a supplementary Environmental Impact Statement, and resolution of the issues identified during the pre-operational readiness review inspection. Until these and other issues are resolved to my satisfaction, WIPP will not open.

This and other potential problems that could affect our weapons production complex highlight the linkage between DOE's nuclear operations and national security. I view the Department's defense activities as an integrated system, where long-term inattention to issues previously treated as peripheral, such as waste management, uranium enrichment, and line management accountability and responsibility, can no longer be tolerated for the system as a whole to work.

In this connection, we also need to address the relatively simple problems of outdated "single track" facilities. We need to instill flexibility in our operations so we can respond to changes or problems within an aging weapons complex. We intuitively realize that "crisis management" is not the hallmark of operational excellence, yet that is what we perpetuate if we allow future technology and capability decisions to be determined by parochial needs.

The nuclear weapons program has been through many cycles in its 40-year history. Over time, the trend has been to correlate closely facilities and capabilities with specific stockpile demands. As the stockpile has declined from peak levels, so too have our facilities and capabilities. We have not planned for resources needed to maintain our sizeable investment.

I am aggressively working on addressing both near- and long-term problems. We must be successful in modernizing the nuclear weapons complex and in conducting effective environmental and waste cleanup efforts, so that we do not jeopardize our strategic responsibilities.

At the same time, we must train our sights on the broader issues that are endemic to the operational problems. For example, we must begin to realize that our past inefficiencies in managing our weapons production facilities have had serious national security implications, not only because inefficient operations are a self-imposed threat to maintaining a viable nuclear deterrent, but also because of the negative impact of improperly managed defense nuclear programs on the future of civilian nuclear power as well. Proper management is essential if we are to see a larger-scale, cultural acceptance of civilian nuclear power sources in this country, sources vital to our overall energy posture and national security. Those sources can help reduce our growing dependence on foreign energy supplies, a threat to national security, and can concurrently move in the right direction environmentally.

Many of the problems facing the Department mirror those of the Nation and our heavy industries. The problems are as simple as outdated facilities, and as complex as mental attitudes. We may no longer be a "front runner" in many key technologies. We are losing our competitiveness. We are falling behind other nations in teaching basic mathematic, science, and engineering skills. We have been unwilling to compensate individuals who wish to enter these fields and serve government. Too many critical components are being designed and manufactured offshore, and foreign ownership of our industries is jeopardizing our ability to develop or commercialize new technology.

We need to revive and emphasize U.S. competitiveness and maintain our technological leadership. Our strategic policies necessitate development of sophisticated technologies such as the Strategic Defense Initiative, advanced conventional munitions, and other high technology efforts, that this Department supports through the national laboratories. The Federal Government, industry, and our university community need to work together to improve our Nation's competitiveness, and this effort has to be on a larger scale. I intend to expand the Department's efforts to transfer new technology to the marketplace, and need support from Congress in these matters if we are to be successful. This Department sponsors state-of-the-art research through its national laboratories and other unique technological capabilities developed by the contractors that operate our production facilities. We must be willing to share this experience base and those benefits in a more structured process than heretofore conceived.

In summary, Mr. Chairman, national security is too important to entrust to today's "single track" strategy. The Department's Modernization Study report presented a broad picture of the options available for assuring the long-term viability of the nuclear weapons complex. However, let me say that I am no more comfortable with the high cost estimates of modernization than I have been with those related to waste cleanup. As a consequence, I have directed the development of a separate 5-year modernization plan to place the essentials of modernization into a fiscally responsible context.

We don't want to repeat the mistakes of the past. Flexibility to meet contingencies, duality, and improved capability are goals that can and should be achieved. I intend to show this Committee that the Department is turning itself around. The initiatives underway at Savannah River will achieve expected results. Progress in other DOE facilities will soon follow. This will take time but, by the end of the summer, you should begin to see the kind of progress that I have promised. As always, this Committee will be kept fully informed of our progress, and the assistance of its Members is absolutely essential if we are to be successful.

Now in closing, you may ask what help will I need from this Committee at this juncture in the FY 1990 authorization process. I will need authorizing language that would allow me to insert new management lines of authority at leadership levels in both headquarters and field activities so as to fix accountability and responsibility for waste management, environment, safety, security, and health within DOE's line management. Today, no such organizational concept exists and, as a result, the contractor executes his contract without adequate day-to-day line management oversight by DOE.

I will work with you to create a comprehensive Epidemiologic Data Repository within the Department of Energy with responsibility for the long-term collection and dissemination of epidemiologic data related to our facilities.

This is a critical period of redevelopment for the Department. With your help we can initiate environmental restoration, new approaches to scientific development through education and training and finally regain technological leadership in the word community by strategically planning our future resource requirements through long range financial commitment within our budget limitations.

Again, I thank you for this opportunity to testify, and want to personally thank the Members of the committee for the support they have given me over the last few months. A good working relationship with the Senate Armed Services Committee is not new to me, but I have been delighted to find my old friendships strengthened as I assume this new position.

THE SECRETARY OF ENERGY
WASHINGTON, D.C.

April 27, 1989

Dear Mr. Chairman:

I made a pledge during recent testimony given on Capitol Hill that I would be ready by mid-April to transmit my first assessment to appropriate congressional leaders regarding startup of nuclear-weapons production reactors at the Savannah River (SR) plant in South Carolina. The purpose of this letter, then, is to provide that assessment.

First, let me enumerate some of the basic principles that have guided my efforts and those of my people to date:

- Restart of any of the SR reactors will not be authorized until I am personally satisfied that they can be operated safely.
- We will call upon all of the technical and other resources necessary to ensure that we will be able to supply, in a timely manner, the required nuclear materials for our national security.
- The problems we face in fixing DOE's nuclear programs go far beyond the specific issues related to the reactors at SR. All of these issues, including at least the following, are to be addressed:
    - The overall management structure of DOE, including lines of authority, technical competence, assignments of responsibility and accountability
    - The DOE management of its major contractors who perform the work for which we are ultimately responsible

- The entire waste problem that has been created as a result of past DOE programs

- Determination of the true picture of what our tritium needs are today and in the future, working in close cooperation with the Department of Defense

Secondly, I have summarized in the enclosure a variety of actions initiated by me to build a workable strategy for safe reactor startup. These actions are structured within the context of the aforementioned principles. For example, they address: key administrative issues; critical environmental protection and waste management issues; nuclear materials other than tritium; other related processes (e.g. AVLIS); and specific SR restart issues.

Finally, despite the significant challenges involved, I am convinced that the projected tritium production needs can and will be met by restart of the SR reactors on a basis of safety that meets exacting standards. In this connection, and although I do not anticipate startup in calendar 1989, I believe safe startup is achievable early enough in 1990 to maintain a viable weapons stockpile. I anticipate that we will have in hand an agreed to startup schedule sometime this summer after all DOE and Westinghouse reviews have been reconciled. I will transmit that schedule, including the actual planned startup date, to you at that time.

Sincerely,

James D. Watkins
Admiral, U.S. Navy (Retired)

Enclosure

(ENCLOSURE TO SECRETARY OF ENERGY LETTER
OF APRIL 27, 1989)

ACTIONS TAKEN BY SECRETARY OF ENERGY TO BUILD A WORKABLE STRATEGY FOR SAFE REACTOR STARTUP OF SAVANNAH RIVER (SR) REACTORS

I. Administrative

- Established a small group of people (15), highly respected in the nuclear industry, to seek out the true state of affairs at SR, so that I can be assured that all relevant key issues are, in fact, under management control. Collectively, this review group has over 500 years of nuclear experience.

- Proposed my new Assistant Secretary of Energy for Defense Programs to the White House, for nomination by the President, in order to help me tackle the extremely difficult task of safe reactor startup in concert with maintaining a ready weapon stockpile.

The individual selected is strong and has a reputation of getting a complex reactor-related job like this done. He has already been working with me voluntarily in his free time to ensure his participation and agreement in actions which I have had to commence prior to his actual nomination by the President and subsequent confirmation by the Senate. Urgency of dealing with the plethora of issues surrounding SR demands these extraordinary interim measures.

o Assigned Deputy Secretary, Henson Moore, and Under Secretary, John Tuck, the task of conducting a detailed assessment of the organization and management of DOE with the requirement that they provide their recommendations to me no later than May 15, 1989. I provided them with a list of basic principles that are to form the foundation of this new management concept. At the base of this foundation is the clear assignment of each responsibility to a specific individual, thereby forcing the line organization to do its job. Fixing line management accountability and responsibility under these principles is fundamental.

o Asked the Deputy and Under Secretary to assess how DOE conducts its contracting business, especially with its major contractors and its acquisitions process. I am concerned about and totally dissatisfied with the process today. They are to make recommendations to me on fixing this problem no later than June 1, 1989.

o Directed changes be made to improve management of tritium inventories and flows to assure that DOE operates at the lowest inventory level prudent to meet demands for nuclear weapons. We have also started to examine our programs for these SR reactors after startup, both in further enhancing safety and in meeting our commitment to a strong defense posture.

o Met personally with Mr. Paul Lego, President and Chief Operating Officer and Mr. Ted Stern, Executive Vice President, Energy and Utilities Systems Group, of the Westinghouse Electric Corporation which operates SR and more DOE sites than any other contractor, and have obtained their agreement that they will make available--without restriction--the total Westinghouse resources to assure that any and all actions taken at sites they are responsible for, are fully proper and technically adequate to protect the health and safety of the public and to produce the product or results intended by their contracts.

II. Environmental Protection and Waste Management

It might be useful to update you on my recent actions regarding environmental protection and waste management so that you know the current status of some of these vitally important programs. While not all of these actions relate directly to the Savannah River restart issue, they clearly must be included as being closely related, both operationally and politically:

- Met recently with senior members of my staff, setting two priorities:
  - My first priority was to require that all DOE facilities develop plans to get facilities into compliance with Federal and State regulations. In those current instances where a site is out of compliance, the Department will seek to establish agreements with Federal and State agencies with which the Department can comply.
  - The second priority was to contain and prevent the further spread of contamination, especially at those sites where technology does not exist to recover the contamination or where the recovery effort would require unreasonable expenditure of funds.
- Initiated the development of a five-year plan for the management of all compliance agreements and environmental restoration programs for the cleanup of the DOE sites. This will be completed by August 1989.
- Personally emphasized to the governors of 17 States my commitment to work with them in restoring the DOE sites and in establishing a strategy and a priority for restoration of the environment in each State.
- Met recently with the President of the National Academy of Sciences and enlisted his support and the application of Academy resources to help establish a system to address equitably the priorities which should be assigned to this national cleanup effort.
- State law being a significant factor influencing compliance with environmental regulations, requested a meeting with a group representing the National Association of State Attorneys General to solicit their review, comment, and support regarding the legal issues associated with the implementation of my five-year plan.
- Found the time allowed for review of the Yucca Mountain Site Characterization Plan by the Governor of Nevada and his staff insufficient to perform anything more than a cursory review of the plan, and extended the review time for the State of Nevada to review this major document affecting the adequacy of the Yucca Mountain Site.
- Similarly, and to ensure time for public participation, increased the number of public meetings and extended the review period for the Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant in New Mexico. In May, I will visit the Waste Isolation Pilot Plant to obtain, firsthand, the status of readiness of that facility and to meet with community leaders, likewise to obtain firsthand their perception of public issues.

Some Members of Congress are saying that I paint a picture that would indicate 40 years of a legacy of environmental negligence. Before I comment, let me quote a few lines from a Safety Review Board report based on their review of a few of our facilities:

"- The disposal of contaminated waste in present quantities and by present methods, if continued for decades present the gravest of problems.

- AEC is entering into a phase where their operations will be public property they will be accountable to public health--a very severe critic?

- The use of tanks for hot wastes certainly provides no solution to a continuing and overwhelming problem.

- The business of constructing more and more...has already reached the point of both extravagance and concern.

- Dumping radioactive and toxic materials cannot be continued for very long in the future.

- The whole problem of the disposal of radioactive and toxic waste needs immediate laboratory and field study...This is one of the areas of research which cannot be indefinitely postponed.

- One of the difficult problems involved disposal of radioactive wastes....Although much deliberation about, and consultation of, disposal of radioactive waste has occurred, no concrete proposal problem exists, at present, for waste disposal."

This report was issued in 1948.

I intend to establish a new and disciplined institutional process which I hope will resolve in the long run problems predicted 40 years ago and apparently ignored. This issue of the environment has seriously damaged the credibility of the DOE. It syphons off the limited capital resources available to the nation and severely affects my ability initiate new major facility programs. Dialogue must be opened with our scientists at the laboratories to arrive at a National Priority System with Administrator Reilly, EPA, for Remediation of Federal Facilities. We cannot be driven from pillar-to-post with inconsistent, unsupported criteria by individual pressure groups. This misdirection of resources will seriously jeopardize the national defense in the future if not addressed now.

III. Nuclear Materials Other Than Tritium

Another consideration that merits some discussion involves nuclear material other than tritium. Actions involving the Savannah River and New Production Reactors are a response to the nation's needs for tritium for our nuclear defense program. I have found that attention must also be focused on the provision of plutonium and highly enriched uranium for our continuing defense needs. The United States has not produced enriched uranium for the defense program for about 25 years. The production of plutonium was severely reduced about 20 years ago when eight of the nine reactors at Hanford were shut down along with one of the five at Savannah River.

Since these steps were taken, the nation's stockpile of these special nuclear materials has slowly diminished, in part because of other non-defense uses found for them and in part for reasons of economy. I have taken steps to ensure that activities of the Department result in availability of plutonium and highly enriched uranium as necessary to avoid impeding or preventing attainment of Defense requirements as approved by the President. Part of the future assurance will be accomplished through restoration of a centralized planning and scheduling capability for special nuclear material, including recycle of nuclear material from weapons being retired.

This planning will provide me with: the basis for improved evaluation of our program plans; review and implementation of the modernization program; more accurate input into the development of the Nuclear Weapon Stockpile Memorandum; and incorporation of new technology in weapons and nuclear material technology.

IV. Other Related Processes to Nuclear Material Production

I am also taking steps to insure no slippage in the program for maturing the Atomic Vapor Laser Isotope Separation (AVLIS) technology into the SIS system, which is slated in a few years for separation of military grade plutonium from the spent fuel remaining from past operation of the N-reactor at Hanford. In the longer term, AVLIS technology is also expected to be used for continuing production of highly enriched uranium for the defense program and low enriched uranium for commercial nuclear power.

In the meantime, I am requiring that plans be laid for early resumption of enriched uranium production for the defense stockpile, primarily to replace the material that over the years was removed from the stockpile for non-defense-related purposes. These were mostly requirements for research reactors in the United States and abroad. Production must also compensate for future removals from the stockpile for non-defense purposes.

V. Savannah River Reactor Restart

With respect to restart of the SR reactors, on April 1st a new contractor, Westinghouse, took over the responsibility for operation. They are a major DOE contractor, with extensive experience, both in military and civilian nuclear programs. Westinghouse has been at the site for a number of months to ensure a smooth turnover. They have been bringing in an experienced management group and have provided a significantly augmented technical resource.

The independent review group, which I discussed earlier, has been conducting an examination of the SR reactors, their operating history, oversight reviews, and actions which address the major issues that have been identified. A conceptual program and a proposed schedule to resolve these issues have been provided by

Westinghouse. This information classifies actions required to assure the safety of the reactors in the near term, and addresses the longer term actions which will support the continued safe operation of these reactors.

As a result of my review, and aided by comments by members of my independent group, I have identified a number of changes needed in the Westinghouse proposal. The proposal must be modified and augmented in a number of areas. The principal requirement is for a detailed program plan for resolving specific issues, with identification of schedules, resources, and the basis for closure on issues. While resolution of technical problems of restart are important, I should like to emphasize that upgrading the training of operators and supervisors is every bit as important. I have made my views on this issue known to Westinghouse. As with the technical problems, this training matter will receive my continuing personal attention.

Senator EXON. Thank you very much. First, the chairman has asked me to announce that during the next vote, which is anticipated around 4 p.m., there will be a committee meeting in the Vice President's office during the rollcall vote or immediately thereafter with regard to reporting out the Herres, Rice, and other military nominations.

Second, I have a note from Senator Kennedy, Admiral. He asked me to express his best regards to you. He had hoped and planned to be here today, but he was called to the floor to manage the debate on the minimum wage bill. He said that he would be in touch with you at a later time and ask some questions for the record.

Let me start off the questioning, then, by simply saying that I support the proposals that you have announced today, Admiral. Once again you have been very forthcoming, and I just want to applaud once again your efforts to institute clear lines of authority in the Department of Energy's management. Clear lines of authority are not only important for all the good reasons but they also affix responsibility that you are very familiar with in your military career. That is what we have to have because we are engaged in sort of a war of our own in cleaning up this problem that we have on our hands.

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Admiral, as you know the Defense Nuclear Facilities Safety Board was established during the last Congress to make recommendations to you on the safety of operations at Department of Energy facilities. Its five members have not yet been named by the President and it is not yet operating. From what you know of the situation, are there amendments or modifications on this legislation that you would support at the present time? Or do you think that we should first give the board a chance to come on board and get up and running before making any changes? Are there any obvious, glaring changes that you think should be made?

Secretary WATKINS. No, sir. I think it is a good bill. I think I need a chance to get it going. I have talked to Senator Glenn about this. I know he has some feelings that we should expand it. I do not think I can absorb an expansion right now.

I think getting these five board members cleared through the FBI and getting their names out in the open so you can review them up here are critical. I know those names have been provided privately by the White House to the chairman and ranking members. They have 100 people to get on board. These are highly skilled people. We are building a mini Nuclear Regulatory Commission. I think it is an excellent concept. It is the kind of classy oversight that is necessary in running a nuclear business, particularly one that dedicates itself to safety.

I would like to give it a chance to get its feet on the ground and then see how we are able to adjust other advisory boards such as the so-called Ahearne Advisory Board. I would see them being relieved by the Defense Nuclear Facilities Safety Board for the defense complex, and by the same token I need the same kind of oversight in the nondefense complex areas.

I would like to shift advisory board responsibility within that Ahearne committee concept in that direction, so that actually I will then have total external oversight advisory capability completely outside my own line management where I still need these same kinds of functions but I need that other eye watching us as we have in the private nuclear sector.

I think the American people will feel much more comfortable, as will Congress, when these are in place and actually functioning.

I think the names that have been sent up here by the White House are superb names. They are balanced individuals with a deep sense of responsibility and knowledge about things nuclear, and I think they will give me, the President, and Congress excellent advice. So I would like just to have an opportunity to let that get established and work. Then you view my actions over the next year, and if we need to revisit and strengthen, I think I would be in a much better position after some of these other variables have been removed from the management ineptness that now prevails there.

Senator EXON. Admiral, you heard my opening statement and some of the subjects that I covered therein.

HAZARDOUS AND RADIOACTIVE WASTE

To effectively manage and dispose of these hazardous and radioactive waste is a tremendous challenge that we all know is there. Do you agree that we should do a better job at marshalling our technological understanding in these many areas so that maybe we can bring other people on board that can give us a big boost?

Secretary WATKINS. Yes, Mr. Chairman, I think we do. With all of the advisory groups, both those required by law and those that I have inherited and somewhat self-imposed, I think that one I clearly need is going to be a Presidentially appointed high-level group of qualified members to help review a year from now development of the long-range waste management plan beyond the 5-year plan I intend to launch this summer. I think when I present that 5-year plan to you, you will probably see that I can manage that.

I do think that one of the weaknesses I have found in the Department of Energy is we have very little long-range thinking of any type, and certainly in this area I think it is critical for the Nation to understand that we do have a vision for the future in dealing with waste. It is not only going to be applicable in the Department of Energy but nationally.

So I believe that the emphasis you have asked me to put on waste management at the laboratories is not only good for defense and Department of Energy facilities but, more importantly, it will include the kinds of things that fall into the area of technology transfer to the private sector so desperately needed as we face the population growth and the difficult problems of dealing with any kind of solid or toxic waste. It is a very timely thing to do, and I believe that if we had the kind of breadth of wisdom that could look way out in the future and help us in that regard, we would be doing a great thing for the Nation as a whole, not just the defense complex or the Department of Energy complex.

COMMUNITY ACTION PROGRAM

Senator **Exon**. You heard me speak of the Cleanup Action Program as a part of the defense bill this year. The program would be designed to coordinate and accelerate the development of technologies for environmental cleanup within the Department. I envision that much of the work will be borne by the national laboratories, including the nonweapons labs, all of whom have much talent to offer us and help us in all of this. What is your thought on this, and could you support such an initiative?

Secretary **Watkins**. Absolutely, Mr. Chairman. I really do feel that I need some authorization language that would allow me to direct new resources at our laboratories in a much expanded waste management initiative.

I am going to be meeting, as a matter of fact, in 2 weeks with all my lab directors. They have already been tasked to get their thoughts in order. They all have good ideas, and they are excited about the concept. These are incredible people, and when you give them a task to eliminate 800 contaminants in our sites, for example, they will give us a fix for every one of the 800. They will prove it. They will do it in short order, and we will begin to put that in context with our 5-year waste management plan. Then we will be able to see what is useful in the private sector that we can take from basic research through concept development through some kind of participatory role with industry and transfer these things to the private sector.

So I think if you will allow me to have that kind of language to give me some flexibility, I would like to broaden it beyond just radioactive waste management or just toxic waste management in Department of Energy facilities. Such flexibility will allow me to set up a technology transfer mode as well to move it into the private sector where it is just as desperately needed.

Senator **Exon**. Very good suggestion, and thank you for your good comments. We are making progress. Senator Thurmond.

Senator **Thurmond**. Thank you, Mr. Chairman.

SAVANNAH RIVER REACTORS

Secretary Watkins, you indicate that new production of nuclear materials is impossible in this country as long as the Savannah River reactors remain out of service. Does this mean that securing new production reactor capacity depends first on the restoration of the Savannah River reactors?

Secretary **Watkins**. Yes, it does. There is no alternative, Senator Thurmond. There is no realistic alternative to getting those reactors on line. Every indication to us now is that we can get them on line. But there is also a very, very great concern on the part of the scientists and engineers who have reviewed the Savannah River reactors. None of them will make a bet on much more than 10 to 15 years maximum time on those reactors. They simply will not do it from a safety standpoint and from their own scientific analysis. So I think it is urgent now that we get on with a dual track, dual production reactor.

DUALITY

Senator **Thurmond**. Admiral Watkins, your testimony makes a case for duality as a national security requirement, and I agree. In the current budget situation, however, and with so much on the plate of the weapons program, how do you prioritize restoring a reliable and safe single-track process providing for duality? Do these two approaches compete for limited resources?

Secretary **Watkins**. Senator Thurmond, that is a very good question. I think the worst thing we could do is to force a decision today on one versus another of the new production reactors. We clearly need a new production reactor. I believe we need two. If you allow the programs to go through 1991, then we could have a flyoff between the two if Congress simply is not going to approve more than one. If we do that today, I could not tell you which reactor. I might make the wrong decision. We have not completed the analysis. Both have research and development problems associated with them. We are talking 10 to 11 years no matter which one comes on. They are all on paper right now.

While people glibly talk about the fact that we have worked with heavy water reactors before and therefore this should not be a problem, let me say that the design of the core for the kind of job it is going to do, to generate tritium, and in building those components, is new. So therefore, it is extremely important we do not make a premature decision in the country and unilaterally disarm ourselves because of something that could conceivably happen even in the interim period with the reactors at Savannah River.

Remember, we are requiring these old reactors to stay on line for 10 to 15 more years while we bring these others on. We have to be very cautious that we do not set ourselves up for another fall later on by having only one source in this Nation tht keeps us from unilaterally disarming while we are going through all the arms control processes. All that is recognized.

Certainly we have to keep our position of strength at the bargaining table every bit as well in the source of these materials as the weapons themselves. Now we have exposed an achilles heel of the United States to the Soviet Union. They are well aware of what Savannah River means to our viable strategic deterrent.

I think all of these things become very important in the discussion of whether we need one or two NPRs. I would say that certainly we should not make any decision on one or the other, and we should go ahead with our development at the cost we put in the budget for 1990 and 1991. Then advise me to come back if I have to at that time and if we do not have the money to let you know which is technically sound, one or the other. Then we will have some real problems because I am going to have to look at keeping Savannah River on the line longer, and I do not know if we can do that. It is going to be a problem, but we will know a lot more in 2 years than we know today. We are still then 8 or 9 years away from putting a reactor on the line anyway.

STRATEGIC CONTENT

Senator THURMOND. You note in your testimony that over the years the strategic content of the Department has been ignored. Would you care to expand on that?

Secretary WATKINS. I think, Mr. Chairman, that the glitzy issues are the submarine, air, and ballistic missile-delivered weapons. Generally, the people feel that deterrence is wrapped up in that system, the triad. We have also learned in the early part of this decade that part of the triad that is absolutely critical and probably just as important to deterrence is the continuation of government and the continuity for a hardened communication system, and that has now been done.

Now we are finding out that we can no longer assume that we can deliver the weapons and modernize the weapons stockpile as generally has been accepted for these 40 years. That process is a casualty. We have just learned that we only have one source of tritium, and that happens to be the long pole in the tent.

So I think it was that kind of lack of strategic thinking on the part of the Department that did not make them feel much more up front in terms of their involvement in strategic deterrence, and it was a shock to me. I never looked over the fence to see where the tritium was coming from. I just assumed that we would take delivery of the weapons at the doors and they would come and be fully ready and modernized on schedule.

The stockpile memorandum said to do it, nobody ever raised any issues, and it was just done. So I think it was a shock to many people even in the Department of Defense that we had a sole source of tritium locked up in those older reactors, and we were shocked by their safety situation and material condition.

Senator THURMOND. I have some other questions, but my time is up, Mr. Chairman. Thank you.

Senator EXON. Thank you, Senator Thurmond.

Senator Glenn.

Senator GLENN. Thank you, Mr. Chairman.

ULTRASONIC TESTING

I think I mentioned in my opening statement about the Westinghouse proposal to not use ultrasonic testing. I think there have been some $20 million spent on that so far. Have you made a decision on whether you want to go forward with that or to go along with Westinghouse on their proposal?

Secretary **Watkins**. We have not made a decision, Senator Glenn, and I do not want to make that decision until I see the entire startup package which is going to be available after some negotiations between Westinghouse and the Department by July. I think it would be premature to say right now what our position is.

On the other hand, there is a considerable body of feeling out there, not just with Westinghouse but with other scientists and engineers that reviewed this situation, that the casual statement that we are going to use this ultrasonic testing of the vessel to make a safe reactor startup determination is not founded in good engineering.

We simply have no baseline of measurement, and if you get into the ultrasonic testing business you have to have an initial solid baseline of reference or you do not know where you stand. So you give this raw data to 15 different people who come up with 15 different answers.

I think we have to be a little cautious when we go into this that everybody knows what we would get out of it even if we got the data and made it a requirement. That has not been determined yet, but I am just alerting you to the fact that there is a growing body of evidence to say we should never have gotten ourselves into a situation where we are implying this is a startup requirement because nobody knows how to use it for a startup requirement sensibly. We are going to reserve that as one of the many items that we have to address when we see the total startup package, and I am not ready to discuss that at this point.

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Senator **Glenn**. When we set up the Defense Nuclear Facilities Safety Board last year, it was claimed that the Nevada test site and Pantex, as two examples, did not pose any nuclear safety risk. I wanted to include them in at that time, and I think we will probably propose that one of these days. Do you support their inclusion under the safety board? Certainly there are risks at those places as well as every other place.

Secretary **Watkins**. Senator Glenn, I would like to put this in the same context I talked about earlier. I have a major study and review of all my advisory boards. I have many advisory boards that overlap. They cross each other in Denver going east and west, and they are the same faces in some cases. It has not been well thought through.

I am getting a Defense Nuclear Facilities Safety Board with five members and a 100-member staff for the first time in history. This is going to be a very, very important board. It is going to be dealing, as you know, with the defense program complex within the Department of Energy, and I plan to take the advisory board under John Ahearne that has been working in the defense side and shift them full-time onto all other facilities for safety oversight and give them the resources they need to do that.

Whether that is subsequently codified in law as another board may come up later. But I would like to be given the opportunity to at least set it up and run it and have you look at it and decide for yourself whether you think that I am doing the job with plenty of visibility up here on the Hill and report to you as required and whether or not that is sufficient in this case.

This is what I would like to do. I do not think I can handle too many more advisory board establishments during this next year's period. I am overwhelmed right now with responsibilities across the board in all these areas, and I do not think I can staff and manage much more.

Also, they are going to be the same caliber of skills that I cannot get now at Savannah River and at headquarters to run my own program in the line. I cannot hire these people. So I have to contract at great expense for oversight, but I cannot get anybody for the line management function.

So this is where I need help with this committee and others to give me some breathing room and some capability to hire the right people to do my job in the first place rather than just give me more oversight function where I cannot carry out what the oversight team is telling me I have to do.

Senator GLENN. We are quite happy and I am sure I would be quite happy to let you get your feet on the ground as to what ones of these groups you think are doing some good and which are not. I would also say, however, that we go back a long way in seeing that many of the problems were not addressed through the years.

Secretary WATKINS. I agree with you, Senator Glenn, and I would have to say that Pantex and Pinellas and all these plants should be looked at by an outside advisory group. I plan to do that with the Ahearne committee. That may not satisfy you, but I think that you ought to give me a chance for the first year to do that and then take a look at my performance and how the reports come up.

Senator GLENN. I gather you would oppose the inclusion under the safety board right now of those other facilities at this time?

Secretary WATKINS. Yes, sir, I really would. I think we have all we can handle to build this new concept, which I think is very important for gaining credibility in the Nation. I am all for it, but I do not think I can manage anything more than that right now.

ORGANIZATIONAL STRUCTURE

Senator GLENN. As a long-term objective, what we are trying to do, what I have been trying to do on this committee and the other one where I am the chair, in Governmental Affairs, is to see that whatever realignment we do of responsibilities, whatever oversight we provide, is set up so that the organizational structure is there for long term for the Department of Energy.

Secretary WATKINS. The organizational structure does not exist today, Senator Glenn. That is what I am telling you. I need the same people who are going to be in your oversight group working to cleanup the mess.

Senator GLENN. If I thought you were going to be there yourself for the next 20 years, I would take a different attitude on this thing because I have all kinds of confidence in your being on top of these things. But the reason we got into some of this mess is because there were other people not as capable. What we are saddled wih is a track record. A second opinion of the outside safety board has been necessary, and it has been a long old process trying to get this under way, as you are well aware. The average tenure of top people in Washington is about 18 months. I hope you are around for the 4 years or, if there is a reelection of the current President, 8 years as far as I am concerned.

Secretary WATKINS. I will be there if you give me a pay raise. [Laughter.]

I will commit to 8.

Senator GLENN. I am for it myself. The point is that what we are trying to do is set up for the long haul when there is a strong leader like yourself in there or sometimes when there may be a less strong leader in there. We need that oversight maybe more than we do once you get reorganized.

Secretary WATKINS. Senator, you know I am sympathetic with you. We have talked about this at great length. I am trying to clean up something that has not been addressed at all. I need that chance because I think you will find if I can clean up 70 percent of the variables in this equation over the next year and expose the real things that have to be looked at by Congress, I think you will feel more comfortable. Right now, we are all jousting with windmills. There are so many things, so many rocks, that I have told my staff to stop turning over the rocks. I cannot handle any more right now.

I think that if I have any more advisory boards that I have to worry about and establish and see that they get staffed, my line is disintegrating rapidly. I just do not think I could stand it. So I think it is going to be inimical to the very things that you are trying to accomplish.

Senator GLENN. My time has expired.

Senator EXON. Thank you, Senator Glenn. Senator Cohen.

BUDGET DECISIONS

Senator COHEN. Mr. Chairman, let me lend my voice to what Senator Glenn was just saying. I supported the creation of an impoundment safety board, and I think it was produced as a result of something you said in your April 27, 1989, letter in which you outlined a report, cited at pages 3 and 4, one of the provisions being dumping radioactive and toxic materials cannot be continued for very long. You point out the report was furnished in 1948. There have been 40 years of neglect, as you, yourself, indicate. That is the reason Congress took the action last year. You have a lot of clean up but that is a good incentive, I think, for that safety board to be over your head, Admiral.

You have recommended in the funding for environmental restoration $1.1 billion, which I think makes about a $408 million increase over 1989. It is going to cost anywhere from $35 to $60 or $65 billion to actually complete the environmental cleanup that is necessary according to GAO plus another $3 to $9 billion to bring the facilities into compliance with the current environmental laws. GAO has indicated that perhaps you could use another $50 or $100 million to help the environmental monitoring problems at Rocky Flats, Savannah River, and Fernald, and also the money could be used for more research and development as Senator Thurmond was talking about in his opening statement. If that is the decision of the committee to provide $50 or $100 million in addition to what has been recommended, which account would you recommend that we cut, Admiral?

Secretary WATKINS. That is a classic question, Senator Cohen. I see no cuts.

Senator COHEN. You do not need the add-on, and you need no cuts?

Secretary WATKINS. I do not think it can be cut any more in other programs and still do what is necessary for the long term. Sure, you can cut the Super Collider out, because what is that going to produce anyway. Those arguments can be made, but I am a strong supporter of things like high energy physics and long-term projection. We do not know what is locked up in the unknowns of the Super Collider, whether we are talking about opening a fusion mystery or whether we are solving superconductivity issues or just what is going to come out of it.

I think that these are the kinds of things that people look to for quick fixes and throwing more dollars into this. Frankly, until I get this 5-year plan put together, I am not at all in agreement with the $35 to $60 billion that we put in our report or the GAO mentioned. I believe it has not been linked with technology. I have seen the inconsistency of the preparation of all those plans, and none of them are budget quality even in modernization of this.

I have already received letters from Congressmen that said "we are pleased to report to you that instead of spending $100 million for cleanup of a site in New Jersey it cost us $2 million." This is the kind of lack of budget quality and professional input that we have had to date, so I am not buying off on those big figures. I think that, yes, I can use more money, and I know exactly where it would go today.

We have worked with the House Members, Congressman Spratt's panel, in this regard and we could probably apply some dollars in very specific areas at Fernald, at Savannah River, at Rocky Flats. I know how to do that. But if you are going to ask me if I am doing it in the prioritized way, in the best way applicable to the highest priority contaminants, I would tell you I do not know until I can get at least the first cut at my 5-year plan in June even before it is finalized in August. So if you will give me that time, then I can tell you exactly what I could do with $50 million or $300 million, as Mr. Spratt is proposing over in the House.

WASTE MANAGEMENT

Senator COHEN. The Department of Energy model that has been utilized and developed is called MEPAS. I am told that it has been criticized by enviromental groups as being too complicated. It differs substantially from the model developed by the Environmental

Protection Agency and also the Department of Defense, in that it calls for data that does not exist and requires an analyst to make a number of assumptions that currently do not exist. Now I am told, for example, that out of 138 sites that will rank in your preliminary report, only 34 used monitored or measured data, that 104 used a so-called moderate or significant amount of assumptions for this critical data. Is that accurate or inaccurate?

Secretary **WATKINS**. Senator Cohen, may I introduce Mr. Leo Duffy as a witness with me today? I have brought in Mr. Duffy, who is an expert in waste management, to be my special assistant for coordinating defense waste management within the Department right now and development of the 5-year plan. I would like to ask him to answer that question for you.

Mr. **DUFFY**. Senator Cohen, I think that refers back to what the Admiral said about the December need study. The data that was in the need study was incomplete. Some of the data was based on not having monitored data, and we believe that part of the 5-year program is to identify what we have to do to get that data.

The MEPAS is under question with regard to its completeness. It is more complete than the existing Hazardous Ranking System in the Environmental Protection Agency with regard to specific sites. We have used MEPAS plus an additional unit called POS, which takes into consideration available technology and funding to give us an adequate description of what the problems are from a risk standpoint. Even the Environmental Protection Agency is revising its current hazardous ranking system. So we believe, as you say, it has additional improvements.

Senator **COHEN**. The Department of Energy has some agreements with States already in terms of identifying those sites that have to have priority. When this final list of sites is arrived at with this final report, will that in any way interfere with the existing agreements, or will you be setting higher or lower priorities on those existing State contracts?

Mr. **DUFFY**. We may change the priorities. In fact, we are changing priorities with the agreement of States. When the agreements are made they identify remedial investigations and technologies that may have to be used with those environmental restorations. Some of the technologies turn out to be not the right technology as identified in the original agreement. We then go back to the State as part of the agreement and identify an alternative that we will use sooner than that while we develop the technology. So I would say yes, we will change technology, we will change priorities, but it will be in agreement with the States.

Senator **COHEN**. My time has expired. Thank you.

Senator **EXON**. Thank you, Senator Cohen, Senator Bingaman.

Senator **BINGAMAN**. Thank you, Mr. Chairman.

Secretary Watkins, welcome, I join others in complimenting you in the way you are getting started at the Department of Energy.

WIPP SITES

Could you go through just quickly again the change in dates that you announced with regard to the WIPP sites so that I am sure I have that and any other change that you announced that affects that opening?

Secretary **Watkins**. Yes, Senator Bingaman. I think it might be useful to just say what a no-migration petition is. A no-migration petition is for hazardous material. It has nothing to do with radioactive material. It is under the RCRA rules. It is an analytical demonstration by the Department of Energy to the Environmental Protection Agency that hazardous waste will not migrate from WIPP for as long as the waste remains hazardous. That is the general rule. We are submitting the petition because it is a requirement that we have no indication of migration of this waste before we put things in a repository.

This is a very interesting repository, in that it is a mobile area with 10 miles of tunnels, as you know. We can remove these things at any time we see that it is necessary to do so. So it is not the classic hole in the ground where we are dumping things permanently. In fact, there are people down there moving trucks, and the proper radioactive control material and wearing the right clothing and so forth.

So our options are limited in this particular case under law. We have no recourse the way the law is written but to submit this no-migration petition at this point in time. It is the first time that the Environmental Protection Agency has ever had such a petition requested of it. They do not have the skills to do all of the work they have to do. But we are helping them in that regard. We have gotten together in an interagency effort to expedite to the extent possible. We thought we could do this in 6 months, but it has taken so long to get this resolved between the Environmental Protection Agency and the Department of Energy that we are here at the 11th hour when we could have done this a year ago but did not. So now we are behind the power curve on this, struggling to try to meet the September date, which we found out yesterday we cannot meet. We physically cannot get through this effort until November of this year, and it is no longer a matter of resources. It is a matter that you just cannot get through the process.

Even then, it is the review data only in November, which can be exposed to everyone, and we can review that. I believe at that time, depending on how well we will be able to minimize waste at Rocky Flats and satisfy the various Governors, including Governor Carruthers, that we can make a determination if we have anything to indicate that we would in fact be violating the toxic environmental laws were we to continue with WIPP if we wanted to start then or whether we wait until the February hearings are all through and we go through the complete formal process.

If we have to do the latter, our best determination today is we can live with it through the waste minimization program that we have already put into effect at Rocky Flats to cut way back in terms of the amount of waste that was being generated there.

We think we can live even with the February date, but I would like to hold off until the fall to see if we might want to come back up here on the Hill to say "this is where we stand, we believe we can proceed with our R&D program," and discuss all the other wickets we have gone through, and indicate we have nothing left but this particular item. There may be nothing in these review papers, and so I think that is a determination we can all make in time working with you and the other people who are interested in this.

Senator **BINGAMAN**. The February hearing you referred to, what is that? I am not clear on that.

Secretary **WATKINS**. May I ask Mr. Duffy to provide a little more detail about that?

Senator **BINGAMAN**. Certainly.

Mr. **DUFFY**. If the Environmental Protection Agency completes their technical review in November, they will then issue a Federal Register notice which will state that they have completed the no-migration petition review. At that time they will announce what their results were and announce a public hearing. Usually it takes about 2 weeks to 30 days for the notice in the Register, another 30 days to schedule a hearing, and then 45 days to resolve comments from the hearing. So that would be a hearing that would be determined by their November data.

TRANSFER OF NEW TECHNOLOGY

Senator **BINGAMAN**. I want to commend you on your statement on page 7 of your testimony where you say you intend to expand the Department's efforts to transfer new technology to the marketplace. You need support from Congress in these matters if you are to be successful. This whole issue of transferring the technology that we have in our laboratories in a way that can be made useful in the commercial sector is one that a lot of us have worked on for some time. If you have specific recommendations of things we should consider legislating to ease this and help to accomplish it, we would certainly like to see those in the next 2 or 3 weeks before we prepare our defense authorization bill here, because I am very anxious to try to be helpful to you in accomplishing that.

Secretary **WATKINS**. We would like to do that, Senator Bingaman. As I say, we are bringing in the laboratory directors here in a couple of weeks, and they have already made some proposals to us. This is to harmonize their thoughts and to organize this in a way where we have a data base that we exchange between all laboratories. People are tasked specifically for certain areas of their best expertise, and they can actually volunteer for some of these particular technologies that we want to work at. One laboratory will be better than another, for example, depending on the weapons development or other program developments they have been involved in.

So we will have something like that, and I think once we talk to them and finalize our own plan, it will give us a clue as to what language might be best for you to give us. This is a new initiative, and we have not embarked on this before. I have assured the Department of Defense that we are not going to encroach on the requirements that they have set upon us in terms of our response in giving them what they need on this. This is to capitalize on the changing strategic picture and not lose these intellectual resources in areas where we desperately need this kind of work. We have seen the era of microchips already in the private sector. This would be the equivalent of a whole range of technologies where we have unusual capability in those laboratories such as lasering, for example, for a variety of purposes.

So at any rate, we will come over. It will probably take just about 3 weeks, but we will keep in touch with your office. It is not so much that you need to give us a lot of dollars. I think we need just the authorization and the recognition by Congress that this is an important initiative so that you are not shocked when we seem to be tasking our laboratories to move in a direction that is outside the normal Department of Defense weapons development context.

Senator BINGAMAN. Thank you. My time is up.

Senator EXON. Thank you. Senator Gorton.

Senator GORTON. Thank you, Mr. Chairman.

PRODUCTION OF TRITIUM

Mr. Secretary, in response to a question by Senator Thurmond, you gave what I believe is a standard and an accurate answer on the urgency of the production of tritium for our nuclear deterrent which was unexceptional. Earlier this month on the Today Show you made a remark which I will quote, "We know how to manage the tritium stockpile within all of the ranges that we have been dealing with on plant startup." I would like you to reconcile those two statements. Was that Today Show remark simply with respect to the short run, that is, the time which will lapse between the date you made the comment——

Secretary WATKINS. Yes. It was in the short-range context, Senator Gorton, of the startup of the reactors, because the question is there have been statements made that unless we started by the end of this year we simply cannot maintain the viable stockpile. Those were premature comments.

Last fall the President ordered a complete review of the stockpile memorandum, a review of all Department of Energy inventories and pipeline processes to see if we can find additional kilograms there to put back into the system. That is underway very aggressively between the Department of Defense, the Department of Energy, and the National Security Advisor. We will be presenting that cause in July to the President, and I think that we will find in there enough flexibility—not a great deal but enough to bring all these things to fruition at about the right time.

There is not much flexibility. We are not awash in the tritium. There are many gurus around the country that are saying we have plenty of tritium. It is just not right. That is nonsense. They do not have access to the same kind of information. We are not playing any games here. We have exposed these tritium curves to Congress. Obviously they are highly classified in terms of the timing and restrictions that are on us. Nevertheless, at this point in time, months into the study, we feel we have been able to demonstrate that we have some flexibility inside the system to work it in a new way, ways that we have never done before. They are the kinds of things that you have to do in extreme situations like this, and we can manage. It is strictly short run. It is not the long run.

Senator GORTON. From the medium and long term, we have an urgent need for an assured supply of tritium, I take it?

Secretary WATKINS. There is no question about it, yes, sir.

GAO REPORT

Senator GORTON. Have you been briefed on and familiarized with GAO's preliminary report on issues surrounding the Department's selection of a new production reactor?

Secretary WATKINS. Yes, I have.

Senator GORTON. Can you give me your general impression?

Secretary WATKINS. I think that the GAO comes down to a conclusion that is not unlike the one that the Department of Energy has regarding the WNP-1 reactor in Washington State. Economically and technically it can be brought on board, let us say, in 6 years or perhaps a little bit more, depending on the tritium target development. So I do not think there is any issue with us there.

I think the issue is, as we sample the waters over here on Capitol Hill, that if we were to bring that kind of issue up despite the fact that there have been reviews by the State Department that said that this would not technically be in violation of nuclear nonproliferation, the intense feeling up here would essentially defeat us. If we go down that path too rapidly, we will find ourselves going into the valley of death as far as getting WNP-1 on the line. So I think it is a political issue, and if Congress would vote to say WNP-1 is the best source—after all, we can get it for this many dollars in this time—and we all agree up here, then I would be pleased to move along.

Senator GORTON. I appreciate your answer to that question. My question was really somewhat more broad. Was your general opinion of the accuracy of the criticisms of last year's process of the Department contained in the GAO report?

Secretary WATKINS. Senator Gorton, if I may ask the Acting Assistant Secretary for Defense Programs, Mr. Troy Wade, to answer that question specifically.

Mr. WADE. Senator Gorton, there are some differences between the figures that were used in the Department of Energy process for life cycle costs and returns on investment from the sale of byproduct steam and things like that that we are indeed negotiating and discussing with GAO. I do not believe, as the Secretary said, that there is any basic difference in the findings; namely—that there are no technical problems that we are aware of that would prevent the completion of the plant, and there do not seem to be any insurmountable technical problems in target development.

Senator GORTON. Mr. Wade, that was not my question. My question was really directed at its criticism of your optimism about the time schedule for any new production reactor beginning from scratch either at Savannah River or at Idaho in which it felt that that time schedule was much longer than your study came up with.

Secretary WATKINS. Let me try a crack at that, Senator Gorton. I do not have a personal feeling about that time schedule. I have been in an intense review of the management regime for NPR. Within a very short timeframe I have an outside group coming in. I have a new prospective director for the production reactors who knows what he is doing. He is an acquisition person, a tough manager who can take these things and look at them and decide whether that schedule that we have is in fact inadequate. It would not surprise me with the track record of the Department of Energy on acquisition management in the past on major programs to find out that we have not done a good analysis on it. That would not shock me, so I would not say right now that GAO is wrong. GAO may well be right.

This is why we keep putting 10 to 15 years on the reactors at Savannah River and why it is so critical—fortunately, we have three of them. With three of them, we can have an upgraded schedule and probably keep those oldtimers working in a safe fashion because of it. Had we not had three, it would have been impossible to achieve any kind of objectives like this with one old reactor, say, with three times the capacity. So I would say that within the next few months we will have a much more accurate feel, and we will be glad to keep you advised of what that is. It will probably be reflected in the 1991 budget discussions, and my posture statement coming over here next year will tell exactly where we are in that management regime. I will feel more comfortable when I have had a chance to take a look at our own new revised schedule as the new director for new production reactors determines. I think he has the quality and the capability and the drive to really understand that. It is a very complex acquisition program, you are right.

Senator GORTON. Thank you. Thank you, Mr. Chairman.

Senator EXON. Thank you, Senator Gorton. Senator Levin.

TRITIUM PRODUCTION

Senator LEVIN. Thank you, Mr. Chairman, and welcome. First, on the question of flexibility that you have just addressed a few months ago on tritium production, you indicated there is some flexibility to meet that need. There could be some short-term delay and still meet that need, I gather from the flexibility comment. Can you tell us approximately when you have to have a start up at Savannah in order to produce tritium to maintain our current stockpile?

Secretary WATKINS. I could tell you in closed session or privately, Senator Levin.

Senator LEVIN. Are you able to give us an idea in public session as to whether, for instance, it is this year, next year, or the year after?

Secretary WATKINS. The cleared position is that we will be able to start the reactors, as I view it now, early enough in 1990 to maintain a viable stockpile. We went over the tritium curves with six Members of Congress on the way down to Savannah River. We will be glad to send somebody to your office to take a look at the first cut at where we are coming out on this thing with the review of the Presidential memorandum.

Senator LEVIN. Are you able to say in public, for instance, if there were tritium production beginning in the end of 1990 instead of the beginning of 1990 whether or not we can maintain the stockpile?

Secretary WATKINS. No, sir, I would not say that in public.

Senator LEVIN. You are not able to say even that generally?

Secretary WATKINS. No, sir.

Senator LEVIN. All right. Is your letter to the chairman dated April 27?

Secretary **Watkins**. Yes, sir. That is the one that talked about the Savannah River startup and the complexity of it, and it went into waste management at some length, the production of materials other than tritium and things that we needed to do in management.

Senator **Levin**. In that letter you indicate that there are a number of issues that have to be addressed, including a determination of the true picture of what our tritium needs are today and in the future working in close cooperation with the Department of Defense. Does that mean there is——

Secretary **Watkins**. That is all what we were just talking about, Senator Levin, the review of the stockpile memorandum and its relation to how much tritium you can squeeze out of a pipeline that was run a certain way for the past 35 years; whether there is any flexibility in that system to tighten it up and get those kilograms back so that we can better harmonize the reactor startup for tritium development and the safe startup of those reactors.

Senator **Levin**. My question is the way that was written, it suggested that that analysis was underway, it was not completed. Is that analysis completed?

Secretary **Watkins**. No, sir, it is not completed. It will be completed in July.

Senator **Levin**. So the June reference that you made before had to do with cleanup, your first cut?

Secretary **Watkins**. The first cut at cleanup.

Senator **Levin**. July is when you will have an analysis of your tritium needs?

Secretary **Watkins**. We will have the analysis of tritium needs, and we will also have probably the first published schedule of the startup of the reactors, including their timing. They will all be coming about the same time, not because we planned it that way. That is just the way it is coming out. It is good that it is, but it was not planned that way initially.

Senator **Levin**. The analysis, then, of the tritium need is incomplete at this date?

Secretary **Watkins**. Yes, sir, it is, but we have done enough analysis for the Department of Energy component of the inventory which we presented to the members who went on our trip to Savannah River to show you, to give you a feeling for the kind of answers to questions that you can then formulate in your own mind.

Senator **Levin**. That same kind of assessment, though, preliminary assessment, is not yet complete on the cleanup side?

Secretary **Watkins**. It is not complete on the cleanup side, but we will have a first cut at it in June and the final 5-year plan developed by August.

Senator **Levin**. Can one state publicly that the restart of a reactor at Savannah would produce sufficient tritium to support our current stockpile at 50-percent capacity?

Secretary **Watkins**. A startup of one reactor? For a few months, yes, sir, but clearly for you to get tritium goal you need all three reactors. You need all three reactors because, in the first place, you have reduced power expectations.

Senator **Levin**. Without argument.

Secretary Watkins. You have to have one reactor down when the other two are going just to keep them going, because we have to mother these things along now for 10 to 11 years, and we have a lot of upgrading to do, a lot of modernization to do on them.

Senator Levin. Then is it your conclusion that the restarting of the three reactors at Savannah would produce sufficient tritium at 50-percent power to support our present stockpile of nuclear weapons?

Secretary Watkins. The best thing I can say publicly, Senator Levin, is that we need all three reactors.

Senator Levin. That would be sufficient?

Secretary Watkins. I do not want to give you the power levels that are required.

Senator Levin. I see, so that at a certain power level——

Secretary Watkins. There is a power level, but you need all three reactors.

Senator Levin. You need all three, and then it would be sufficient to——

Secretary Watkins. Obviously we have a sequential startup plan, but you do not normally start up three reactors at the same time at a site. It is too big a management plan on any site, commercial or otherwise. So there is a sequence of startup that we can also talk to you about.

Senator Levin. Just so that we get a clear answer, the three reactors started up sequentially when finally started up at a particular power level would produce sufficient tritium to maintain the current inventory?

Secretary Watkins. That is correct, sir.

Senator Thurmond. That would not be for the long term, though, would it?

Secretary Watkins. That would have to go for about 10 to 11 years until new production reactors came on line unless we decide that the Nation wants to move into WNP–1 startup with special targeting or whether we want to restart N–reactor. There are other potential sources in the interim period but not very many options. So obviously, the statement that I made earlier holds true, this is not forever. There is not one engineer or scientist I have talked to who would give you a nickel after 10 to 15 years, and they are very, very worried about that. We are going to operate these reactors safely, and we simply do not know all the unknowns that are out there on old machines like this.

Senator Levin. My time is up. Thank you.

Senator Exon. Thank you, Senator Levin. Before we recognize Senator Gore, who is next, let me ask this question. Unfortunately, I had a conflict in my schedule and could not make the trip that you referred to. Was the curve that you talked about regarding tritium any different than the curve explained to us 2 or 3 weeks previous to that trip here in this committee room? I do not believe you were here, Admiral Watkins. I know Mr. Wade was. Due to the classification involved, I am not asking you what it was. I am just asking was there any significant difference between what the subcommittee was officially told in this room in closed session and what you told the members who accompanied you on the trip?

Secretary WATKINS. The baseline data was identical, Senator Exon, but we really should get back to you to have you look at the flexibility margins that we have been working on on this study under the direction of the President for reviewing this situation vis-a-vis the stockpile memorandum. You probably ought to see that. It is not significantly different. Probably in your own mind you would get very specific on power level, very specific on expected startup times, very specific on startup intervals with reactors, and for the first time it puts some numbers on what might come out of this July study. So we are trying to keep you updated as we go along, and you probably ought to see that.

Senator EXON. Thank you. Senator Gore.

FLEXIBILITY IN THE NUCLEAR MATERIALS PRODUCTION CYCLE

Senator GORE. Thank you very much, Mr. Chairman. Admiral, some of the questions I was going to pursue have been explored with you, but as I take it, the main theme of your testimony is the need for flexibility in the nuclear materials production cycle. Yet, many in the public equate flexibility with expensive redundancy. You are telling us that your proposals will not produce redundancy. Is it your view that your predecessor was wrong in saying we are awash with plutonium?

Secretary WATKINS. Absolutely. He has tried to undo that for a long time, Senator Gore, and was unable to do it. What he meant to say was we have fuel grade plutonium at Hanford particularly—and we have it at other places, too—of significant quantity; in fact, 16 reactor years of fuel grade plutonium that with the special isotope separation system can give us the amount of plutonium we need to carry out the stockpile memorandum direction of margins. That is what he meant. There is a lot there, and you do not need to generate more. That is why we can dedicate the three reactors in the interim period before new production reactors come on line to tritium only. We will not need it providing we use the SIS.

Senator GORE. It is also your view that the HGTR is needed even with new construction at Savannah River?

Secretary WATKINS. Yes, sir, because I believe anytime that you have the sole mission of the new production reactor, let us say the heavy water reactor 10 or 11 years from now at Savannah River for tritium only to meet 100-percent goal and you have no other source of tritium or plutonium, you stand in danger of the very thing we are talking about here today, and our successors are going to say why were you so dumb not to have duality and have some flexibility in your system, because you just had a tornado or you just had a major fire and you were shut down for 3 years.

This is the kind of thing you cannot stand again, and I think for the Soviets to have 11 reactors after even having shut down 3 and for the Soviets to have the capability to target these things in their 42 commercial reactors when we do not tolerate that raises serious questions about our management plan unless I come up here and tell you that I think we need at least some flexibility like one reactor plus a little. We are only talking about four modules in a high temperature gas-cooled reactor for 50-percent goal. So it is not even 100-percent goal. So it is not redundant to that extent, but it does give you some flexibility when you have these kinds of hiccups that we will surely have in any major production plant of this type anywhere.

CLOSING OF NUCLEAR FACILITIES

Senator GORE. Now you mentioned the Soviet Union. General Secretary Gorbachev has proposed closing some nuclear facilities. You have mentioned some of the asymmetries in the nuclear complexes in the two countries. Why could we not go ahead and implement an existing agreement to put all U.S. civil nuclear plants under IAEA safeguards? The reactors are under the safeguards agreement, but it is my understanding, and correct me if I am wrong, that we have not paid to have resident IAEA inspectors. Why not counter the Soviet initiative by implementing that plan, putting them under the safeguard, and then challenging the Soviet Union to do the same?

Secretary WATKINS. I will have to give that a lot of thought, Senator Gore. It is just something I have not looked into. I think it is a very complex issue, and I would like to get a chance to answer that for the record. I really have not given that a lot of thought.

Senator GORE. Well, I hope you will.

Secretary WATKINS. It raises so many issues in my own mind about what the intent is. If the intent is nonproliferation, then I would understand that. I am not sure why you are asking.

Senator GORE. Are you worried about the Russian initiative and the effect on world public opinion if we have no response at all?

Secretary WATKINS. I happen to think that in operating its nuclear powerplants, this country since Three Mile Island is far more sensitive to health and environment and safety than the Soviet Union. We know that. We have watched their safety practices and they are virtually nil. We are not like that.

Senator GORE. I understand that, but the question is aimed at this competition for public opinion, largely in Europe, in which the Soviet Union is besting us at present, and the aspect of the competition under your jurisdiction includes this matter.

We can tell ourselves all we want, that we are great, we are safe, and we are doing well, but when he makes these bold new initiatives and we have an opportunity to capitalize on openness and strength and the existing separation between civil and military and to present a much bolder counterinitiative, then at very little expense we make a move that forces the competition to a new level and works to our advantage. I will look forward to your response for the record.

[The information follows:]

The United States has a treaty with the IAEA for the application of safeguards to U.S. facilities, which was ratified by the Senate in December 1980. Under this treaty, the IAEA can apply safeguards to all U.S. nuclear facilities not engaged in direct national security activities. A list containing the 240 facilities currently meeting this criteria has been provided to the IAEA. The eligible list includes all NRC licensed power reactors as well as some DOE facilities. The IAEA, if it so chooses, may select all 240 facilities for safeguards application. However, this would require a doubling of the total IAEA safeguards staff.

IAEA inspectors are employed and paid by the IAEA regular budget. The IAEA determines the inspection effort required for each country, which is based on the number and type of facilities being inspected. Historically, the agency has selected only a few facilities for inspection at any one time in the United States.

The Soviet Union did not enter into a similar treaty with the IAEA for the application of IAEA safeguards in the U.S.S.R. until 1985. Additionally, the offer by the Soviets is limited to 35 facilities, which is a fraction of the total number of facilities that the Soviet Union could offer for inspection by the IAEA. The Soviets are being encouraged to increase the number of facilities under IAEA safeguards.

Secretary WATKINS. Let me just make another comment, Senator, because I think it is germane. A few days ago about 21 nations met in Moscow for the World Association of Nuclear Operators hosted by the Soviet Union as a result of Chernobyl. The United States was part of that and was very much involved.

Senator GORE. Team members from TVA were there, too.

Secretary WATKINS. We were very much involved in assuring that the Department of Energy approved the participation of the Institute of Nuclear Power Operators, which is the arm, as you know, of the nuclear industry of this country, to be there. The accomplishments there, I think, were impressive already and the reports we are getting back is that it was a very productive conference and we will move more to exchange not only views but technology on safe reactor design. That could come out of it. We will have to look at the Atomic Energy Act and see where that goes from here.

I believe there is a movement in that regard right now, and I think that is the vehicle to walk in an evolutionary way with the Soviets into something like this. We have participated with them, and I believe that should get some publicity. I think that is a step in the right direction on risk reduction and for mutual respect. They are very much involved now in the international exchange of information on safe reactor operations, and I would say this is the way to go. Let us try to build this thing as rapidly as we can and capitalize on that kind of interchange, not unlike the Law of the Sea Agreement we have with them. That was extremely successful.

I believe this is the way rather than to try to make political hay out of something that I think is not necessarily in our best interest. I really do think that we have more to give than to receive on that, and we can give a lot to the Soviets on this.

Senator GORE. I will provide other questions for the record, but in closing, Admiral, let me just clarify. I do not see it simply as a matter of making political hay in the international environment. That is a side benefit. I see the competition in that realm for public opinion as in many respects very healthy. We can use that political leverage to push them toward something that is in their interest and in the world's interest. I am not putting it just in the political context. I think it is something that we ought to do and urge them to do. I look forward to your response for the record. Thank you, Mr. Chairman.

Senator EXON. Thank you very much. We have Senators Nunn and Wirth who have not had their first round, and I would be happy to recognize Senator Nunn.

Chairman NUNN. Senator Wirth, I would be happy to defer to you. I have been in and out.

Senator WIRTH. Please go ahead.

HIRING DIFFICULTIES DUE TO FEDERAL PAY CAPS

Chairman NUNN. Admiral, I know you and I have talked about this also, but in today's Washington Post it states that you are having a difficult time hiring qualified candidates for key positions in the Department of Energy due to Federal pay caps, conflict of interest laws, et cetera. This problem is not unique to the Department of Energy, but it seems to me the Department of Energy has a unique kind of responsibility now that is unlike other departments in the sense that you have a lot to do in a pressurized atmosphere because you have a safety problem that you have acknowledged, you have a waste problem, and you have a modernization problem, and they are all converging. You are going to have to address them with the very best personnel possible, particularly with the complexity of your domain. What kind of personnel problems are you having in terms of your hiring? What roadblocks have you run into? Do you have any suggestions?

Secretary WATKINS. Senator Nunn, I think it is one of the most serious problems in Government. We saw some of the impact of the pay raise demise with people retiring early, people looking at the ethics laws, and saying that it was incompatible with their future potential to serve almost anywhere in their own field. I have a situation where the basic laws that established the Department of Energy require that anyone who comes to me from a laboratory cannot go back to a laboratory. So I have gone through several candidates who have wanted to come in and serve as Assistant Secretary of Energy for Defense Programs, and they are willing to come in but they cannot take the $40,000 per year salary cut.

Chairman NUNN. They are making that much more at——

Secretary WATKINS. It is the same everywhere, Senator. It is not just me. In the Department of Defense, I understand that Dick Cheney has gone through 18 or more candidates for an acquisition position. Now how do we get somebody from industry to come in and take a $100,000 to $200,000 salary cut, beat him over the head and shoulders with ethics laws, hammer him up here on the Hill, and expect him to go into the Department of Defense happily and take that job? They say no way am I going to do it for that, and also I cannot go back to industry.

So how can we make the Government work that way in technical areas? I cannot get the people to go down to Savannah River to man the reactors down there that I want working in the Department, not working for the contractor. I can pay Westinghouse big bucks to go down there. I cannot add a nickel to the mediocre salaries that we give some of these highly technical people who I have to steal from industry.

Chairman NUNN. In effect, what you have to do is either go the contracting-out route or the consulting route. You almost cannot have in-house staff.

Secretary WATKINS. Senator Nunn, I cannot do it, and I will tell you why. I have to have my management responsible to me as the Department of Energy representatives on the site to manage the day-to-day operations of the contractor to make sure they are carrying out their contract efficiently. This is done everywhere, but I cannot get the people to come in. I have to beg, borrow, and steal, and rubber hose them to come in, and if they are good public servants they will come and work for me. That is about the best I can do.

I need some flexibility. I do not need a thousand billets. I need a handful of billets anyway at least for management to try to get some of these people in with a skill. Here we are, trying to start up some reactors to assure the national deterrent. This is unilateral disarmament we are involved in, and I cannot pay somebody $100,000 instead of $80,000. Yet we are willing to put $3.5 billion per year into cleanup. It makes no sense. I cannot even clean up right because I cannot get the people to come in. I mean, how many people do you know who love waste management? [Laughter.]

This is a tough technical area, and somehow we have to come to grips with this pretty soon or I think we have a blueprint for disaster in the Federal Government. I think it is getting worse as we see more and more technical issues being raised that we have to solve with technical people. We do not even have them in the Nation. As you know, that is a whole other issue. We do not have the base of technical people out there, so I have no choice but to compete. I need help both financially and in the ethics area so we do not make such silly rules that say I cannot put a person back in a lab.

I have a 52-year-old person who wants to come right now and be a Principal Deputy for the Weapons Program, highly respected by all the laboratories, can run the laboratories, a super person, the best in the business. He cannot do it for two reasons. He cannot go back to the lab, which is his life. I can set up some internal ethics rules that do not permit him to go feather his bed back here and then go back to the lab and reap all those rewards. That does not happen in a laboratory. These are intellectuals. They do not even think in those terms. I really think it is a mistake. We need to change that part of the law at least for a handful of people for me.

Chairman NUNN. I am very sympathetic to the case you make because we have talked about it. I think something has to be done. If we really are serious about doing something about nuclear waste, if we are serious about modernizing our facilities so that we can preserve the deterrent, and if we are serious about the environmental and safety problems, then we have to do something about your personnel problem. The difficulty is going to be to do it in your agency without having every other agency wanting to do it, and then it will take 2 years to get it done if it gets done at all.

I wish Senator Levin were here because I talked to him about this briefly. Senator Glenn is not here, and the Government Affairs Committee would play the key role here, although we might be able to do it on our bill. I could not do it without their concurrence. What I was thinking about doing is to have about 10 or 15 slots, somewhere in there, that we would waive specifically some of the present Government laws because of the situation you are in, including the possibility of dual compensation waivers. I know you have to go to the military field for all these nuclear specialists. Would it help you if we were to give a waiver on 10 or 15 slots for, let us say, a 2- or 3-year period for people who you need, retired military?

Secretary **Watkins**. I think it is essential, Senator Nunn, and you could put any kind of constraints on it. Put a sunset clause on it, or admonish me to let you know what I am doing, what the salaries are. There are a lot of things you can do, but I desperately need that. I need it right now for leadership primarily both here and at Savannah River as well as other sites. So what we are talking about is a foot in the door of something that maybe after a year I would encourage you to review again because we are not talking about big dollars when you are talking 10 or 15 people. You might be talking about big dollars in terms of 1,000 or 1,500, but we are not talking about that.

Chairman **Nunn**. You said about 15 people for waiving dual compensation, and you also have to plan a way to carve out an exception on that laboratory problem, do you not?

Secretary **Watkins**. Yes, we do, we really do, and on the conflict of interest. I think this can be worked under a rather simple change of law. We have looked at what might be required there, and we would be pleased to work with you staff to show you what we have come up with. It might kill two birds with one stone; that is, either the dual compensation or the lab return and lab salary situation.

We looked at the University of California at Lawrence Livermore, for example. The standard salary of a top weapons scientist is about $120,000. There are a lot of benefits. It is important that we not ask that person to come in and take a big salary cut. Just leave them at the same salary. I could probably get some advisory capability now by just stealing that individual from the University of California but that is not the way to do it. We want the permanent employee under the Department of Energy so the accountability and responsibility are right there, and I do not want it in some other laboratory. That is kind of the order of magnitude that we are talking about. It would be about $40,000, in my guess, per person to keep them at about the same salary at least from the weapons side.

Chairman **Nunn**. Could we by law keep them paid at their present salary and let the laboratories pay them, or do you have to pay them on your payroll?

Secretary **Watkins**. I do not know that, Senator Nunn. We have reviewed the laws. I do not have them with me, but I can work with your staff and give you a draft of what I think would satisfy both needs, both the ethics and the cost needs, and not be excessive.

Chairman **Nunn**. Do you think you can get the other Cabinet officials not to pile on this legislation if we try to get it through? We have to get it through the whole process and do it quickly if it is going to do you any good.

Secretary **Watkins**. I will talk with my good friend, Richard Darman. I think if we kept it to a small number—I think Dick Cheney needs it. I believe maybe the Environmental Protection Agency needs a couple. I think everybody needs a little bit of this. At least it is a first attempt to satisfy some of the needs in the aftermath of the defeat of the pay raise for them.

Chairman NUNN. I am willing to undertake that. It is going to take a lot of work to get it done, and I hope we can do it quickly enough to do you some good.

Secretary WATKINS. If you could do it just for the Department of Energy as a kind of a demonstration program, just this year, anyway.

Chairman NUNN. I will get Senator Bingaman to take a look at it, if you could give it some attention. I want to ask Senators Levin and Glenn as well as Senators Warner, Thurmond, and others, because we have to figure out something. I think you have a problem that cannot be solved without good personnel. You have to have them. Senator Warner, would you mind taking a look?

Senator WARNER. Mr. Chairman, I spoke earlier today with the Secretary. As he well remembers, we started to work 20 years ago this month, as a matter of fact, on special legislation to cure comparable problems in the U.S. Navy where we were losing special categories of officers with training which would have been paralytic to certain elements of the naval submarine program. The Admiral brings with him the benefit of having worked in the Bureau of Naval Personnel, and he recognizes the impact of this type of selective legislation on at that time of other branches of the Navy, but I think there is a direct correlation to other branches of the Federal Government.

I will join with the chairman. Mr. Thurmond and I will do that together, but at this time I wonder. I asked the counsel for the minority side to do a little independent research at the Department of Defense. Would the Chair indulge a brief report from counsel on this question?

Chairman NUNN. Sure.

Senator WARNER. Mr. Tucker.

Mr. TUCKER. Thank you, Mr. Chairman. I think Admiral Watkins has mentioned the problem that Mr. Cheney has, that between 18 and 24 persons have now elected not to accept the position of Under Secretary of Defense for Acquisition. Many of those persons have cited the level of pay or the conflict of interest statutes that they would come under as the reason for refusing. Several senior officials of NASA have left their positions in the last 3 to 4 weeks, citing both the loss of pay raise and the conflict of interest positions. NIH has lost in the neighborhood of 100 senior scientists and doctors in the last year, citing the same problems. In fact, even today military departments are beginning to have difficulty in recruiting scientists because of the pay problems and also more and more because of the conflict of interest problems. So it is really a difficult problem.

Senator WARNER. Mr. Chairman, I bring those facts to you and Mr. Exon and other members of the committee because while I have the highest respect for my personal friend and his articulate presentation today, I am not so certain that we can deal just with one department in view of the critical nature of this problem. I would be perfectly willing to join with you and other members of the committee in writing a letter to the President bringing to his attention this testimony and our firm belief that the Admiral and his Department require prompt attention as well as other departments under the jurisdiction of this committee; namely, the Department of Defense.

Chairman NUNN. Yes, I know they have problems, too. Of course, I see this one as the more urgent of those that have been named, although I am sure every department can cite their urgency. I just think we have some problems here that are not going to wait for a couple of years of scurrying through the legislative process to see how we can cure these problems for the whole Government. If you try to cure for the whole Government, you are talking about late fall at best if everything goes smoothly for getting something through.

Secretary WATKINS. I would agree, Senator. I think 15 positions will help me on the Savannah River startup. That is going to be very, very clearly focused there. You could even restrict me to that because that is where it is going to go. I need it there. I need it both in headquarters and at Savannah River, but it is connected with the startup and the skills I need to bring in there. That includes the weapons side because I cannot separate the weapons skill area in the defense programs from the reactor startup. So I need those two skills, and it all involves the defense complex work at Savannah River.

Senator WARNER. You have made your case, and I think that we are prepared to accept your representation as being a state of fact and one which the executive branch and Congress are going to have to join together to resolve. Again, having just met earlier today with the President on not specifically this issue but certain issues which are tangential to this one, he recognizes the problems right now in staffing up his new administration and bringing in the quality of people that he and the American citizens expect to take on the enormous responsibilities of this Government. We are fortunate to have you, however. I have known your career and respected it for a long time. Of course, Mr. Wade, you may be an incidental beneficiary of whatever action we take, but we are grateful that you have hung in through these many, many years to come before this committee. You are a very valued and respected witness.

Chairman NUNN. Senator Exon, I think I have taken my time, and I know Senator Wirth is ready.

Senator EXON. Thank you, Senator Nunn, thank you, Senator Warner. Senator Wirth.

Senator WIRTH. Thank you very much, Mr. Chairman. Mr. Secretary, thank you for being here. I want to share particularly the words of Senator Warner for you, Mr. Wade, I think you have been just exemplary in all this, and we are lucky to have you.

CLEANUP AND MODERNIZATION PROCESS

As you know, I remain very concerned about the process of cleanup and modernization in the weapons complex. It is my understanding, Mr. Secretary, that in terms of modernization of the new plant, we are looking at $100 billion over a 20-year period of time, and in the cleanup we are looking, by your figures, at about $85 billion over 20 years. GAO estimates that to be about $150 billion over 30 years. Those are generally accurate figures, are they not?

Secretary WATKINS. They may be accurate taken from the report. I do not consider them representative of the kinds of dollars that are budget quality that will come out of our 5-year plan both in modernization and in waste management. They are not technology linked. They are not done under any standards. They were done the best they could with a quick shot at it. Even the data that I have read in the report that accompanied the 2010 Report coming to the Hill has serious flaws in budget estimation.

Senator WIRTH. Do you think they are significantly high, or you just do not know?

Secretary WATKINS. We just do not know. My belief is they are high because they are not linked to technologies that we have yet to focus on to try to cut these costs down. I brought in Mr. Duffy because he is familiar with this. We do not even exchange the information with our sites to tell them what is cheapest to use, so we did not tell them which technology to apply. So they are bulldozing a football field worth of stuff 100 feet down to take to someone else's State. That is not going to work, and we have other technologies that we can use to deal with surface water and ground contamination of all kinds, and in a cheaper way that they were unaware of.

FIVE-YEAR PLAN

Senator WIRTH. Have you all made a decision at Hanford to embark upon a very ambitious cleanup program there?

Secretary WATKINS. That is correct. We just signed the agreement.

Senator WIRTH. Hanford was way out in front of the other facilities in terms of the analysis or looking at the technical side of it; is that correct?

Secretary WATKINS. No, sir, but the Hanford agreement was in preparation for a year. It was initiated before I ever took over this particular assignment. This is the final agreement. I made it very clear to everyone that there is an article called Article 139, of that particular agreement, that makes it very clear that the costs that were assumed to exist, the so-called $2.8 billion, are not the cost that I foresee to carry out the provisions of compliance with either State or Federal law on environment. So I am not going to endorse cost. I am going to endorse getting rid of those contaminants.

We will put those into the 5-year plan in very definitive terms and work with the States and get agreement on that 5-year plan. We will change our budget process so you will see the budget lines against those contaminant reductions and exactly how technology is linked to be able to accomplish this purpose.

Senator WIRTH. Is Rocky Flats going to be within that 5-year package?

Secretary WATKINS. Yes, sir, it is.

Senator WIRTH. With the same kind of technology-based design that you are talking about at Hanford?

Secretary WATKINS. Yes, sir, it will be. You will see this. Everyone will see it, and I hope——

Senator WIRTH. When is that going to be out?

Secretary WATKINS. In August 1989.

Senator WIRTH. That is probably going to be a very significant jump-up in cost in a 5-year period of time.

Secretary WATKINS. In my opinion there will be a ramp-up initially but a significant ramp-down after about the first 5 years because of the technologies that we will couple in the out-years. We will have to accelerate the up-front studies so we can get the technologies moving in our laboratories, and that program does not exist today.

Senator WIRTH. What you are telling us is that there is going to be a very significant commitment that we are going to have to authorize in this committee to meet what will be the 5-year goal defined in August?

Secretary WATKINS. I think the administration, when we have the 5-year plan and we get our 1991 budget prepared, will recognize that we have a budget quality, hard, tough analysis there that we have worked out with the States and will commit the funds. That is my hope. So I am not saying what the ramp will have to be. I hope the administration, if we do our job right, will see the merits of getting on with this investment up front for the long-term decline in the out-year costs and cut these things down significantly.

Senator WIRTH. Here we are again, Mr. Chairman, with the very disturbing testimony we got a week ago from the General Accounting Office on the extraordinarily major commitments in the Department of Defense for a $300 billion package that we are going to have to do an awful lot of squeezing to get those long-term commitments that have been made at the Department of Defense into the $300 billion package.

GAO went on to tell us on the Department of Defense that if we stayed within the constraints of Gramm-Rudman, that was going to cost another $25 billion over a 5-year period of time, and if there were realistic inflation estimates that would be yet another $25 to $40 billion in alleged cuts that would have to be made or commitments against a limited budget.

We then come on to say, okay, on top of that we are going to be talking about significant modernization and the commitments that have to be made for rail/mobile and for Midgetman. All of that is bad news enough for a budget, and now we are going to see a very significant jump-up, I understand from what you have just told us in a 5-year estimate——

Secretary WATKINS. Senator Wirth, I do not want to say a significant jump-up. I am going to say that there have been questions raised about the linearity of the ramp for 20 years in the 2010 Report. Senator Glenn has made the point that we therefore need $1.3 billion instead of $800 million in the fiscal year 1990 budget to accomplish that. I have said I cannot use that amount right now. I do not know how to apply it.

Senator WIRTH. Just looking at the out-years.

Secretary WATKINS. In the out-years, I do not believe the ramp will be there. I think the total cost——

Senator WIRTH. Looking at the out-years there is no ramp at all in the Bush budget, as you know. The only point I am making is that we have some very, very significant commitments of funds against a budget that just cannot handle all of those things. That is flat the case. We are kidding ourselves if we think that we are going to be able to put all these things in.

Now part of that has got to be the examination of looking at the number of reactors that we are going to build. In response to earlier questions about whether we need two reactors or could get away with doing one, you said that there was a significant national security backup requirement that we have, very justifiable. I understand what you are saying, if there is some storm problem or fire problem or some other hiccup in the system, to use your word. It just seems to me that as we look at this budget situation, I am not sure that we have the kind of money to do the sort of brain surgery to take care of a potential hiccup. We may have to cut back very dramatically in this to meet the budget envelope that is going to be available to us.

I raise this not in any way, shape, or form, Admiral Watkins, to be contentious in the face of your suggestion, as you have a job to do and are doing it wonderfully and I am delighted that you are down there, but only to do everything I can to bring us back to the reality of this budget situation, which is very, very, very bad. We heard that last week from the General Accounting Office in brief, I thought, and pretty stark, almost frightening terms. When we factor in the other places that we have to think about from your perspective only to clean up, that is a big cost. Then to think about the other commitments of the Department of Energy adding further to that, we just do not have the money to do these things, and we are going to have to make some tough decisions in your area just as we are in the weapons syustems that Dick Cheney is responsible for.

I would submit that the budget is going to tell us we ought to start thinking very sharply, for example, about building one reactor rather than two and about looking more imaginatively at how we can do a better job of managing the current plant that is available. We just are not going to have the money to do all of those other things.

There is no reason you have to respond to that in one way, shape, or form. I just sit here and listen to all of these demands, and there is nothing for you to say, I do not think, other than we may be at the point where we are only going to be able to do one that is just the way it is going to be. Thank you very much, Mr. Secretary. We are delighted you are here.

Chairman Nunn [presiding]. Thank you very much, Senator Wirth. Senator Thurmond.

Senator THURMOND. Thank you, Mr. Chairman. Admiral, I have known for a long time that you are a very competent and experienced nuclear engineer and could earn at least a quarter of a million dollars a year out in civilian life. After today's hearing, I am now convinced you could earn a quarter of a million dollars as a salesman. You are a super salesman, and I am glad you are because this subject needs selling. We have to mold public opinion to accomplish this purpose.

INEFFICIENCIES IN MANAGEMENT

Admiral Watkins, your testimony states that past inefficiencies in managing our weapons production facilities have had serious national security implications. Could you very briefly be more specific about those inefficienceies and how the executive and legislative branches could prevent them in the future?

Secretary WATKINS. I think probably the biggest inefficiency, Senator Thurmond, probably derives from the decline from the very competent Atomic Energy Commission staff, its relationship to a very competent Joint Committee on Atomic Energy here in Congress, the years of that close association with probably some of the finest minds in the Nation that came out of the Manhattan Project and other things, working in close harmony with the Energy Research and Development Agency, ERDA, then into the Department of Energy in 1977, and then the threat of abolishment of the Department of Energy. When you do that to an organization and it is not well thought through, it is hardly a place that encourages new hires to race into.

We have an organization that has been sitting, in my opinion, moribund for at least 8 years; not the people. I am talking about the process now of not giving the attention we needed to the various important events that were going on at this particular time in the Nation. So I believe that what we are seeing here is a management malaise born out of that track record which has given rise to, frankly, a nonmodern management regime within the system both here and in the field.

When I talk to people like the directors of the labs who are some of the best minds in the country, they are yearning for direction and leadership. They want to know what to do. They want to be tasked. They are ready to be tasked. This has not been there for a variety of reasons. I do believe it derives from that sort of thing, and that is the inefficiency that has been generated. No line management accountability and responsibility for field operations, for example.

So we wait every day hanging onto our desks in there now as to where the next shoe is going to fall. Who is going to provide a urine sample now that has uranium or plutonium in it? Who is going to sue us again? We have more suits against us then you can shake a stick at. We cannot get the repository into Nevada. We have a suit there. We have a $300 million suit at Fernald. Everybody is suing us. One of the reasons they are suing us is we have not had the line management out there on a day-to-day basis with outreach to the communities, to the States, doing the jobs, being open in our exchange with them, hiding under collegial secrecy that has been there.

I do not blame anybody. It is just that we have all allowed the situation to evolve this way, and it has given rise to significant management inefficiencies across the board. It is everything from waste management to managing our sites safely and securely, to environmental noncompliance, to health inattention.

I am asking for epidemiological support here because that is an area that is woefully inadequate. We ought to know exactly what is going on around our sites. We ought to have those studies done routinely. I am getting with Jim Mason, my old friend at the Centers for Disease Control who is now the Assistant Secretary for Health in the Department of Health and Human Services, and we are going to be working very hard to work up a new plan in the near term to get this epidemiological data and to set it up as a matter of routine. These are the things that are not even there today, and that is what the management inefficiencies are.

INDICATORS OF PROGRESS

Senator THURMOND. Admiral, you indicated that by the end of the summer we should begin to see the kind of progress that you have promised. In your view, what will be the indicators of that progress?

Secretary WATKINS. You will have the published reactor startup schedule for Savannah River. It is going to be tough. It is going to have tough milestones. It is going to be hard to reach, but we are going to bring in the best management team. If we can get some help from this committee on giving some incentive to bring the right people in, I think we can do it. We have a good outfit in Westinghouse down there. They understand the magnitude of the problem, and I think working together we can do that. So you will see that schedule. That has not been published yet.

You will see the new 5-year waste management plan in August, and that is critical. That is going to have to be worked with all the States, and I think we can gain some credibility with the Governors, with their congressional representatives here on the Hill that we finally have something.

We are going to tailor a whole new budget line-item for waste and for our modernization program in our weapons complex so that you can see up on the Hill where the dollars are going.

By that time we will have our laboratories tasked to demonstrate in the 5-year program that we have technology linkage so that we can demonstrate that these costs in the out-years need not be $100 to $150 billion. I think that is going to take a lot of the negative comment about this particular issue off the table and perhaps might even encourage the restart of a sensible nuclear power program for private electrical generation.

So between now and August, I can see all of this taking place along with the review of our Department of Defense needs in tritium and other issues, and I hope by that time we have the indication from here on the Hill that you all are going to support the critical new production reactor or at least let us continue with that work for the next couple of years on the new production reactors.

Let us go ahead with SIS. I know that is a controversial issue up here. You can look at supply and demand curves, but again my estimation is we ought to listen to the President when he asks us to have certain margins in there for potential breakouts stemming from failure to achieve the kind of START agreement or other agreements we might have with the Soviets. Don't put us into a bargaining position where we simply have no cards left in our hand in a tough poker game played by some very competent people.

So I want to start considering the Department of Energy long poles in the tent, like Savannah River, new production reactor, SIS, and things just as important to the nuclear deterrent and to demonstrate the will of the Nation as the weapons themselves, because in fact they are the precursors to the weapons.

K-REACTOR COOLING TOWER

Senator **THURMOND**. Admiral Watkins, in the current budget environment the two Committees on Armed Services have questioned the over $130 million investment in a cooling tower system for the K-reactor at the Savannah River site. This is because of the potentially limited operational utility of the system which we now understand cannot service a future new production reactor. If Congress could provide accelerated funding for environmentally equivalent projects at the Savannah River site, would you support a limited duration waiver of the existing law with respect to the K-reactor cooling tower project? The cooling tower is not going to service the new reactor. It seems that some steps should be taken to save the money and have a tower that will take care of the new reactor.

Secretary **WATKINS**. Yes, I would, Senator Thurmond, very much so. I would like also, if I may, Senator Thurmond, to allow Mr. Duffy to maybe expand on that a little bit. That is a very important issue, and right now all of the lawyers tell us that we have no recourse but to proceed with request for funding of that tower. We have talked both to the House and to you all about it, but I think if Mr. Duffy could add a few more comments on it, it might be useful.

Senator **THURMOND**. Admiral, excuse me just a minute. That is the 5-minute bell for a vote, so we are going to have to leave. I have another engagement, so I am going to ask the chairman if he could place the answers in the record.

Secretary **WATKINS**. We will supply additional information for the record then if that is all right with you, Senator Thurmond.

Senator **THURMOND**. Thank you, Mr. Chairman.

Chairman **NUNN**. Thank you, Senator Thurmond.

[The information follows:]

The Department of Energy (DOE) has discussed with the South Carolina Department of Health and Environmental Control (SCDHEC) on numerous occasions alternative environmental projects to the K Reactor cooling tower. SCDHEC has always held the position that meeting thermal discharge requirements is a requirement of the law under the Clean Water Act (CWA) and the State of South Carolina water quality standards and is not a matter of establishing environmental priorities. Therefore, SCDHEC has concluded that in order to operate K Reactor, DOE must either build the tower system to meet the law or have the law changed by Congress. DOE concurs in this determination. It is the Department's position that the expenditure of money required to build the cooling tower could be better utilized in other environmental projects at the Savannah River site. However, unless congressional relief from the CWA is given, the Department will fully support the expenditure of funds required to construct the K Reactor cooling tower.

Chairman **NUNN**. Admiral, let me just ask a couple of quick questions. It will take 15 or 20 minutes to vote and to get back, and most people have asked their questions so I am not going to keep you all waiting. We have some that we will have to ask for the record.

Secretary **WATKINS**. Thank you, Mr. Chairman.

ORGANIZATIONAL MANAGEMENT STUDY

Chairman NUNN. You have an organization management study under way or you have just completed. Have you completed that yet?

Secretary WATKINS. We have completed it for the Savannah River startup plan to get the line management responsibilities in both headquarters and in Savannah River for environment, safety, health, and security that we now do not have. Those people are not there, but the plan is there, and I hope it will be put into effect by June 1. It will be announced Friday. We have a few things to fix on it, but basically it is there, and I will be sending copies of that over to this and other committees that are interested.

Chairman NUNN. Okay. We would like to take a look at it.

Secretary WATKINS. That will be the first step. This is the first step in a major reorganization effort that will take place probably over a year's time, and we will be keeping you informed every step of the way so that we have concurrence up here on the Hill on what we are doing. I think you will see the wisdom of what we are trying to do across the board, so it is not just Savannah River.

DOE 5-YEAR PLAN

Chairman NUNN. You heard me outline in my opening statement the 5-year plan legislation that I would tentatively, at least, plan to submit as part of our defense authorization bill. How do you feel about that 5-year plan for the Department of Energy?

Secretary WATKINS. Absolutely. As you know, we are doing that. We need any support you can give us to help us produce that plan on schedule and then to maintain it over the next 5 years and to keep it dynamic and moving with new technologies as they come along.

SIS FACILITY

Chairman NUNN. Thank you, Mr. Secretary. You are going to begin operating an isotope separation facility within the next 5 years for the purpose of creating a plutonium contingency. The question I have is why should we devote $1 billion of our very scarce resources to create a plutonium contingency when we will not have a tritium contingency before the end of the century and quite likely beyond that time? In other words, what is the rush on that plutonium contingency?

Secretary WATKINS. I think we have all seen the curves, and you have certainly been provided them up here in closed session, Mr. Chairman. I would have to reach to the larger issue. I have seen those curves, and I have seen the margin of flexibility that is lost by SIS disappearing on a supply and demand basis and were you able to deliver with the Savannah River reactors in tritium, and were you able to take advantage of the mining of existing weapons and perhaps some additional plutonium might be available at Rocky Flats, you might be able to move along the bottom edge of the curve. My problem with that is that it assumes everything works right in the system. It is almost a scholastic review of a graph that everybody can grasp very quickly.

So when we see an excursion of SIS that takes you up into the margin of what I would call judgment in dealing with potential needs for plutonium where we cannot turn the switch on and off very rapidly, if we do not have anything to turn on such as we will not have at Savannah River—even if we get it back on line, that is solely devoted to tritium development—we have a need, in my opinion, to be able to demonstrate that we can generate weapons grade plutonium if we need it. That can best be done both from a cost effective point of view and in the 1995 to 2005 timeframe by the SIS. We have proven it is significantly cost effective to do it that way.

Now if you say, well, we do not need the plutonium, that is not my determination to make. My determination is based on the requirements of the Presidentially-directed stockpile memorandum which says I need a certain margin of flexibility which you are not giving me if you do not give me some additional source of weapons grade plutonium.

Chairman NUNN. Are you not getting more reserve with SIS if you get it than you have ever had in the Department of Energy?

Secretary WATKINS. I am sorry, Senator.

Chairman NUNN. Are you not getting a reserve that you have never had before with that plutonium in SIS?

Secretary WATKINS. Let me ask——

Chairman NUNN. In other words, my understanding is that we have operated for the last 40 years without it. The question is with all the problems we have now and all the money we have to spend now on waste, environment, safety, and modernization for tritium, why are we creating a reserve now that we seem to have done without for 40 years?

Secretary WATKINS. Let me put some corporate knowledge back into the discussion. Assistant Secretary Wade has an answer for that. You are right, Mr. Chairman. It is a margin we have not had before. We have not complied with the stockpile memorandum in the past. Obviously this decision was made before I was here. I was not a party to it, but I personally think it makes sense to have the capability.

Chairman NUNN. I am sure it does from a theoretical point of view, but I just wonder if it can be a part of the priorities we have right now. Let me ask you to supplement that for the record.

[The information follows:]

At present there is an adequate supply of plutonium. It is not as large a supply as desirable, but it is providing a measure of protection from a potential material shortfall. Our projections show that as we approach the mid-1990s, the adequacy of the supply, in the absence of any capability to produce new weapon-grade plutonium, will diminish substantially.

This situation is unique when compared to our previous 40 years in that, up to now, sufficient production capacity existed to meet both current requirements and desired reserve. In the foreseeable future and certainly not prior to 2005, this may not be the case. The proposed SIS production plant would provide a capability to produce new weapon-grade material and the only foreseeable means to establish a plutonium reserve.

Failure to provide this capability could impinge on the ability of this Department to respond to national security needs, since there is no contingency capability for additional material should it be needed.

The issue of SIS is a basic one of flexibility and capability to respond to national needs if required by the President and national security decisions.

Chairman **Nunn**. I am going to miss this rollcall vote if I do not depart at this moment, and I do not want to keep you all waiting for 20 minutes. So we will adjourn the hearing and be back in touch with you. Thank you for coming, Mr. Secretary.

Secretary **Watkins**. Thank you, Mr. Chairman.

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR SAM NUNN

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Senator **Nunn**. As you know, last year Congress established the Defense Nuclear Facilities Safety Board to provide independent, objective advice to you on the safety of DOE's defense facilities. The five members of this board are to be appointed by the President with the advice and consent of the Senate. The law required the nominations to be submitted to the Senate not later than 180 days after enactment, which means that the deadline for these nominations was March 27, 1989. The law provides that an explanatory report is to be submitted to Congress if these nominations are unable to be submitted on time. To date, the committee has received neither the nominations nor a report explaining the reasons for the delay. Do you know the status of these nominations? Do you know why we have not received a report?

Secretary **Watkins**. The White House recently transmitted the names of the President's nominees for appointment to these positions to the Senate for consideration.

PLUTONIUM CONTROL ACT

Senator **Nunn**. What are your views on proposals to halt United States plutonium production unless the United States and Soviet Union negotiate an agreement ending production of plutonium and highly-enriched uranium?

Secretary **Watkins**. The International Plutonium Control amendment to H.R. 2461, the fiscal years 1990 and 1991 DOD Authorization bill, urges the United States to terminate operation of its plutonium and uranium facilities as long as the President can determine that the Soviet Union has ceased such production, and the Soviet Union and the United States were in a process of negotiating an agreement to end production of plutonium and uranium for weapons use.

Our successful national security strategy since World War II has relied on an effective nuclear deterrent, a deterrent that is strong and flexible in responding to changing policy needs. That strength is the prime reason that we were able to achieve arms reductions that resulted from the Intermediate Range Nuclear Force (INF) Treaty. This policy of negotiating from a position of strength is a proven method of achieving arms reductions.

Even if the United States and Soviet Union had similar supplies of fissile materials for weapons, a cut-off now would freeze a potentially destabilizing asymmetry in place.

The Soviet Union has the flexibility to use its power reactors to produce additional plutonium for nuclear weapons, the United States does not have this flexibility. Under the proposed cut-off the Soviets would be prohibited from producing plutonium for weapons but could continue to produce plutonium inherently as part of its civilian breeder program. Further the Soviet RBMK reactors could be used as plutonium production reactors in a breakout scenario.

This legislation puts national security at risk. Not only would it limit the availability of nuclear materials, it would, under some verification scenarios, open militarily critical facilities and technology to unprecedented foreign access. Further, it would force this Nation into a position of weakness in negotiating any nuclear arms control agreement.

The act would seriously limit the Nation's flexibility in responding to external threats if, as it clearly intends, our nuclear production facilities were shut down. Then we would be unable to provide for future needs by producing materials in the short term and we would be unable to resume production quickly enough to respond to a national security crisis.

For years our carefully thought out policy has been that security needs, not the availability of special nuclear materials, should determine the size and composition of the Nation's nuclear stockpile. The International Plutonium Control Act would reverse that policy. Inventory, not national security, would control defense policy, putting this Nation in a dangerous and untenable position.

STANDARD FOR SHUTTING DOWN DANGEROUS DOE FACILITIES

Senator NUNN. What standard do you follow in determining whether a DOE facility presents a public health, safety, or environmental risk sufficient to warrant shutting it down? What other DOE officials have such authority?

Secretary WATKINS. In instances of undue risk, i.e., unacceptable operating margins of safety, or clear and present danger to workers or members of the public, a shut down order would be given by DOE management. Clear and present danger, as defined by DOE's Order 5480.1B, is a "condition or hazard which could reasonably be expected to cause death or serious harm to plant workers or the public immediately or before such a condition could be eliminated through normal procedures."

Also, according to DOE Order 5480.1B, Line Managers, i.e., the chain of command that extends from the Secretary through Program Senior Officials (Assistant Secretaries for Defense Programs, Nuclear Energy, Fossil Energy, Conservation and Renewable Energy; the Directors of Energy Research and Civilian Radioactive Waste Management, and the Administrators of the Power Administrations) to Heads of Field Organizations have responsibility and authority to take such action as may be appropriate to ensure acceptable environment, safety, and health performance. This includes directing the curtailment and suspension of operations when, in their opinion, such operations pose undue risk.

The Assistant Secretary for Environment, Safety, and Health is also authorized under certain conditions to direct a curtailment or suspension of operations. DOE Order 5480.1B states that "in the event that the Secretary is unavailable, EH-1 (Assistant Secretary for Environment, Safety, and Health) is authorized to direct the Program Senior Official or field element to suspend or curtail an operation which EH-1 has determined is posing a clear and present danger until the danger is mitigated."

Shut-down authorities for the Department's nuclear facilities are subject to review and possible amendment in virtue of Secretary of Energy Notice SEN-6-89, issued May 19, 1989. This Notice set in motion enhanced line program accountability and responsibilities governing safety oversight.

PLUTONIUM PROCESSING FACILITIES

Senator NUNN. One of the recommendations of the 2010 study was the relocation of the Rocky Flats Plant to a more remote location. One of the principal functions performed at Rocky Flats is plutonium processing of retired weapons and of scrap material, which are our principal sources of plutonium for new weapons. DOE is requesting almost $400 million over 10 years to modernize its plutonium processing operations at Rocky Flats. At the same time, DOE needs over $1 billion to build a special isotope separation (SIS) facility at Idaho, part of which will contain the same plutonium processing capability as Rocky Flats. Are you considering the possibility of transferring the plutonium processing operations to Idaho on a schedule that would not require spending the full $400 million at Rocky Flats, a site DOE has indicated it would ultimately like to close? Do the delays in completing the SIS technology demonstration at Livermore, as evidenced by the reprogramming request before the committee, suggest that the construction of the SIS laser facility may also have to be delayed? If so, does this create an opportunity to focus on the plutonium processing capability that will be part of SIS as a means of relieving the burdens at Rocky Flats?

Secretary WATKINS. The current mission of the SIS facility is to provide the capability to purify existing DOE-owned plutonium to weapon-grade requirements, thus providing a prudent level of contingency for meeting material requirements arising from potential increases in demand or disruption in the ongoing recovery of existing material. In order to accomplish this mission, the SIS facility has an extensive balance-of-plant plutonium processing capability which could at some future date complement or provide a degree of backup to some Rocky Flats processing operations. Currently, processing these materials is heavily dependent upon aging facilities whose reliability is not assured. The Plutonium Recovery Modification Project (PRMP) at Rocky Flats is needed to provide an ongoing reliable capability for processing plutonium scrap and returns, permit operational phase-in should a new facility replace Rocky Flats, and perform the site cleanup operations associated with the eventual decommissioning of the Rocky Flats site.

Deployment of the SIS capability would thus provide not only an assured capability to meet weapon-grade plutonium requirements in the interim to full NPR deployment beyond the year 2005, but also some contingent plutonium processing capability for ongoing Rocky Flats operations subject to technical, safety, and environmental review.

Subject to necessary funding support in Congress, the current SIS program development and deployment schedule will realistically result in facility startup in 1996. This availability reflects the one-year schedule impact of the anticipated fiscal year 1990 congressional funding cut of $75 million to the $123 million level and the DOE decision to prepare an Environmental Impact Statement prior to a decision to conduct prototypical demonstrations with plutonium at the Lawrence Livermore National Laboratory. The deployment of both the PRMP and the SIS facilities will help ensure the ongoing capability to maintain and service this Nation's nuclear deterrent.

NEW PRODUCTION REACTOR

Senator NUNN. Last summer DOE announced a plan to build, on a concurrent schedule, two new production reactors, one, a heavy water reactor at Savannah River to meet 100 percent of the expected tritium requirement, the other, a modular high-temperature gas reactor at Idaho, to provide an additional 50 percent of the expected requirement. You, as well as many other knowledgeable experts, have expressed concern about the current state of DOE's technical talent and have said that "retraining and reeducation of the crew to a new culture, which places environment, safety, and health on an equal par with operation is the long pole in the tent." I agree with your assessment and support the efforts to reform and upgrade DOE's management and safety culture. In light of these current shortcomings, how will DOE successfully manage a concurrent effort to build two new production reactors? Will available resources—both people and dollars—not have to be stretched too thin?

Secretary WATKINS. I do not believe that our resources will be stretched too thinly. Currently, we have assembled in the Office of New Production Reactors an appropriate and necessary mix of federal and contractor employees who are actively involved in getting this vital effort underway. Their single dedicated mission is to bring new production reactor capacity on line on an urgent schedule. We are also bringing on line the best personnel that industrial America has to offer and this is being supported by a matrix of national laboratories. Furthermore, we have contracted for the utilization of a utility engineering group (UEG), Duke Power, which will provide additional technical expertise. Fiscal year 1989 funding has proved to be adequate and we expect no additional financial problems providing the fiscal year 1990 request is appropriated as requested.

Senator NUNN. In testimony before the committee earlier this year, Dr. John Ahearne, Chairman of the Advisory Committee on Nuclear Facility Safety, stated that he has considerable "concern about the ability of the Department to pull together enough effort, knowledgeable effort, to develop the ideas and the concepts for two new designs (for two new production reactors) at the same time." Do you share his concern?

Secretary WATKINS. No, I believe that the Department can more than adequately handle the job. Within the Office of New Production Reactors we have a DOE and contractor staff which, collectively, has over 600 years of nuclear experience and we are still in the process of staffing the office. In addition we are also tapping into a great deal of contractor and consulting talent in the nuclear industry which will provide some of the best personnel that industrial America has to offer. This is being further supplemented by the use of Duke Power as a utility engineering group and we are also supported by a matrix of national laboratories.

Senator NUNN. According to your plans, the New Production Reactor at Savannah River will produce 100 percent of the tritium requirement for $3.2 billion, while the high temperature gas reactor (HTGR) will produce 50 percent of the need at a cost of $3.6 billion. Isn't that a rather expensive "second source" of tritium—more than double the cost? How carefully has the Department studied other options like converting the WNP-1 reactor or developing the accelerator technology? Are you prepared to certify that the HTGR at Idaho is the second most cost-effective source of tritium?

Secretary WATKINS. The Department undertook a thorough examination of available reactor technologies to determine the best approach for providing new production capacity. As part of the preferred strategy, which resulted from this evaluation, work was to continue on developing a light water target as a contingency. Also, a full analysis of the use of WNP-1 will be included in the Environmental Impact Statement (EIS). With respect to the use of accelerator technologies, the Department has tasked a panel of the Energy Research Advisory Board to further evaluate the use of accelerator technologies for the production of tritium.

At this time we are not prepared to certify that the HTGR at Idaho is the second most cost-effective source of tritium. The only cost data available is based upon proponent provided estimates. The Department will have more accurate cost estimates after completion of conceptual designs. This will be accomplished prior to any deployment decision being made.

MODERNIZATION COST ESTIMATES

Senator NUNN. The 2010 study concluded that the costs of modernizing DOE defense facilities could be determined by assuming that plant and capital equipment would be replaced at the rate of 4 percent of its value per year. This 4 percent replacement rate is often compared with an average of 4–7 percent per year for commercial industry and with DOE's historical average of less than 2 percent replacement rate. However, in addition to modernizing at this 4 percent replacement rate, the 2010 study indicates that additional funding is needed for specific projects above and beyond what this 4 percent rate would yield, such as the new production reactor and so forth. Do you believe that modernization requirements have been overestimated by using such a formula?

Secretary WATKINS. No, the historical funding average of 2 percent, when compared to a normal 4 percent to 7 percent, has not allowed the DOE to adequately maintain the weapons complex. Several important elements of the complex are approaching a critical state. As a consequence, the major projects were included as separate items in the modernization report in an effort to catch up with where the complex should be. Once that is accomplished, the approximate 4 percent funding level requested will allow the DOE to provide the complex that is necessary to support the nuclear weapons program.

SPECIAL ISOTOPE SEPARATION PROJECT

Senator NUNN. The SIS project's estimate of total project cost has seen a steady increase since 1986. From 1986 to 1989 the estimated total project cost rose from $862 million to $1,231 million, a nominal increase of 43 percent. This cost escalation can be explained in part by the experience that as design matures and more is known about what it will take to build the project a more realistic cost estimate is developed. Given this experience, when is the estimate of final cost expected to stabilize? What parts of the project could see further cost growth?

Secretary WATKINS. Although it is correct that the total project cost (TPC) has increased by 43 percent since 1986, it should be noted that the component representing the actual facility cost (TEC) has increased from $504 million to $599 million, which represents less than a 20 percent increase. This is a direct reflection of the evolution of the design from the conceptual stage to 30 percent of a definitive design. Over this period, there have been significant increases in research and development (R&D) estimates, reflecting prudent intensification of work at Laurence Livermore National Laboratory to assure that the first-of-a-kind hardware is fully qualified prior to the start of significant construction and procurement activities. The uncertainty of defining R&D scope and predicting associated costs has led to these cost increases; however, this phase of the program is nearing completion. A recent DOE decision to perform an environmental impact statement prior to operation of the engineering demonstration system with plutonium is expected to increase development costs by less than 8 percent.

Following successful accomplishment of the plant performance verification test series at Laurence Livermore National Laboratory, a decision to proceed with significant construction and procurement will be considered. This anticipated milestone will mark the conclusion of both the major development and design evolutions. Development and deployment costs will be well defined prior to a decision to deploy, and any project cost uncertainties beyond this juncture should be of a general construction nature.

Senator NUNN. The SIS project's fiscal year 1989 validation report states that preliminary construction is scheduled as early as 30 months before the testing and demonstration of SIS technology is completed. Also, in his October to December 1989 progress report, the SIS project manager reported that the scheduled completion of the SIS prototype plant may slip an additional 4 months. This apparent development of a concurrent research and development and construction schedule is in contradiction with the recommendations of DOE's own project review team that construction not begin until SIS technology had been successfully demonstrated in integrated tests. How has this concurrent schedule come about? Can further schedule slips be expected? What construction activity could be delayed to avoid the problem of concurrence?

Secretary WATKINS. As stipulated in the SIS Record of Decision, the current schedule reflects that successful results of the plant performance verification testing are to be obtained prior to an upper management decision to proceed with significant physical construction. This precludes significant concurrency of development and deployment. Prior to the decision to proceed with major construction and procurement, a small and reversible site preparation effort of less than $2 million has been scheduled to cost-effectively remove it from the critical path of facility construction at projected savings of 6–9 months and $50 million. Delay of this activity would not be prudent in terms of project cost and schedule versus the limited risk involved.

Concerns with the schedule relationships originally expressed in the fiscal year 1989 validation report were addressed and basically resolved as doumented in the October 1989 update to the fiscal year 1989 validation report.

Although development and deployment schedules for first-of-a-kind facilities are difficult to accurately predict, it is anticipated that the current schedule for 1996 facility startup is fully attainable. This, however, is subject to the availability of necessary and timely funding, a timely and favorable Record of Decision on conducting tests with plutonium at the Lawrence Livermore National Laboratory pursuant to the preparation of an Environmental Impact Statement, and the successful accomplishment of development milestones. As presently structured, the SIS program minimizes the problem of concurrency and depends instead on a technically sound and disciplined decision process.

Senator NUNN. In a May 26 hearing on an $11 million reprogramming for the engineering demonstration system of SIS, Assistant Secretary Troy Wade testified before the House Armed Services Committee's panel on DOE defense nuclear facilities that the reprogramming was in part the result of the difficulty in predicting the funding needs and milestones of a leading-edge technology as SIS. Given this difficulty, has consideration been given to delaying construction until research development milestones have been satisfied?

Secretary WATKINS. Successful completion and review of the development demonstration test results are and have been since the inception of the construction project, prerequisite to an upper management decision to proceed with major construction and procurement. Accordingly, proper management of project funding necessitates occasional reprogramming of funds to ensure the cost-effective and timely completion of the development performance tests prior to a decision to deploy. For instance, the priority associated with the recent decision to prepare an Environmental Impact Statement prior to the decision to conduct developmental performance tests using plutonium may require some reallocation of funds between project accounts.

QUESTIONS SUBMITTED BY SENATOR J. JAMES EXON

CLEANUP AGREEMENTS

Senator EXON. According to testimony given by the Environmental Protection Agency earlier this year, DOE, EPA, and the States have concluded three cleanup agreements and expect to complete eight or nine more this year. Do you concur in this expectation, and do you believe it is necessary to establish a date certain by which all such agreements will be completed?

Secretary WATKINS. DOE is committed to cleaning up its sites consistent with the Environmental Restoration and Waste Management 5-Year Plan, announced by Secretary Watkins in August 1989. Negotiations for cleanup agreements are ongoing for 16 DOE sites and negotiations are expected to begin shortly for similar agreements at other sites. It is possible that these negotiations could result in a number of executed agreements by the end of the calendar year. However, it should be pointed out that each of DOE's sites is different and consequently negotiations at each site are complex and require resolution of specific site issues. In addition, negotiation of these agreements requires dedicated efforts on the part of EPA and the affected States. As a result, it is very difficult to establish deadlines for completion of negotiations.

To increase State involvement in the Department's environmental programs, the Secretary of Energy has directed in his 10 Point Initiative that DOE begin negotiations with States that host DOE facilities to achieve comprehensive agreements that provide for joint oversight roles in monitoring environmental compliance at the facilities. Each agreement is to provide for independent validation of environmental data, environmental cleanup schedules, and for assisting in establishing priorities necessary to meet negotiated schedules. The agreements will be similar to the comprehensive agreement between DOE and the State of Colorado regarding environmental compliance at Rocky Flats Plant. The Secretary of Energy directed the Deputy Secretary to initiate negotiations for similar agreements with other host States by July 30.

CONSENT DECREES

Senator EXON. What are your views on whether the cleanup agreements that DOE, EPA, and the States are in the process of negotiating should be enforced as formal "consent decrees?"

Secretary WATKINS. Because of the overlapping requirements of the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), DOE's cleanup activities are generally overseen by both EPA and the States. In order to minimize the possibility of duplicative or inconsistent requirements being established by different regulatory authorities, DOE prefers to negotiate schedules and workplans to which State regulatory authorities, EPA, and DOE can jointly subscribe. Because EPA and DOE are executive branch agencies, they cannot be joined in a lawsuit on opposite sides, and cannot be parties to a consent decree that could involve them in adversarial proceedings. DOE therefore believes that negotiated Federal Facility Agreements are preferable to consent decrees.

ROLE OF DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Senator EXON. How do you envision the legislatively-established Defense Nuclear Facilities Safety Board functioning in relation to other DOE safety organizations, such as the Ahearne Committee and to the DOE Office of Environment, Safety, and Health?

Secretary WATKINS. I have directed the first of a series of measures to establish a strong line management organization within the Department. I have further directed that each of the DOE line organizations provide properly qualified supervisory managers to ensure that this newly constituted and strong internal safety oversight function is quickly integrated into the line programs. Effective internal safety oversight is the essential ingredient of holding day-to-day managers accountable for the safe operation of the facilities under their supervision.

Proper external checks are also essential to provide desired independent oversight of the Department's line organizations. This dual track concept—internal and external oversight mechanisms—is well understood in the commercial nuclear power industry but the concept was not previously adopted by DOE. The five-commissioner Defense Nuclear Facilities Safety Board (DNFSB), and its potential 100-member staff, will provide independent, high-level safety oversight of certain DOE defense facilities. The President recently submitted the names of his five DNFSB nominees to the Senate for consideration and I expect that the DNFSB will be operational within several months. The Advisory Committee on Nuclear Facility Safety (ACNFS), commonly referred to as the Ahearne Committee, was established in November 1987 and is currently performing a similar function. It is my intention that the ACNFS cease independent external oversight for any operation within the purview of the DNFSB upon notification by the Chairman of the Board's readiness to assume their legislatively-established independent external oversight responsibilities. Since the DNFSB's responsibility is directed at certain defense facilities, I intend to continue the ACNFS and to focus their oversight activities on those other nuclear and non-nuclear operations where DOE would benefit from high-level, independent, and external safety oversight.

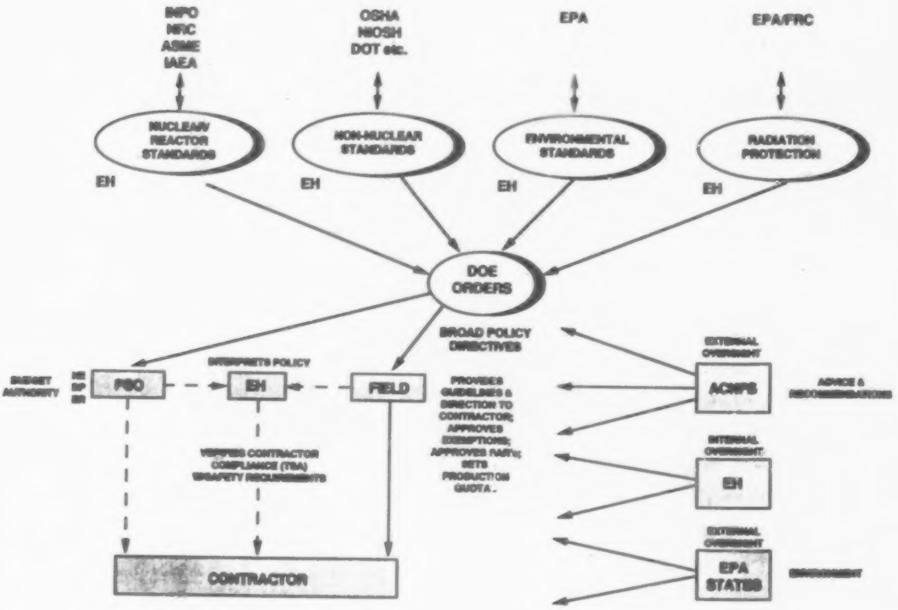
Within this well-defined framework, line management is wholly accountable for safety. Since the principal task of oversight—whether internal or external to DOE—is to promote safety within line organizations, the new organizational system that I am establishing will result in a management system that not only identifies deficiencies but seeks to attain operational excellence, not just minimal compliance with requirements.

To be successful, all headquarters line organizations will be responsible for developing the technical capability within their offices to provide proper technical guidelines and directives for field implementation. These line offices within headquarters must also oversee and verify that the contractor is complying with all directives. As a result, the function for internal oversight will reside within line organizations.

With the exception of nuclear reactor safety matters, the DOE Office of Environment, Safety, and Health (EH) will continue to provide independent oversight for environmental, safety, and health activities at all DOE facilities (DOE will rely on either the DNFSB or the ACNFS for independent oversight of nuclear safety activities): EH will continue to perform independent on-site inspections and appraisals and develop departmental policy related to environmental protection, radiation safety, worker safety, non-nuclear safety, and those aspects of public health and safety that deal with epidemiology and radiological protection at DOE facilities.

I have attached two diagrams that depict the relationship among the various internal and external oversight bodies under the current and my proposed organizational alignment.

CURRENT ALIGNMENT


INPO
NRC
ASME
IAEA
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NIOSH
DOT etc.
EPA
EPA/FRC
NUCLEAR/ REACTOR STANDARDS
NON-NUCLEAR STANDARDS
ENVIRONMENTAL STANDARDS
RADIATION PROTECTION
EH
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DOE ORDERS
BROAD POLICY DIRECTIVES
BUDGET AUTHORITY
NE
DP
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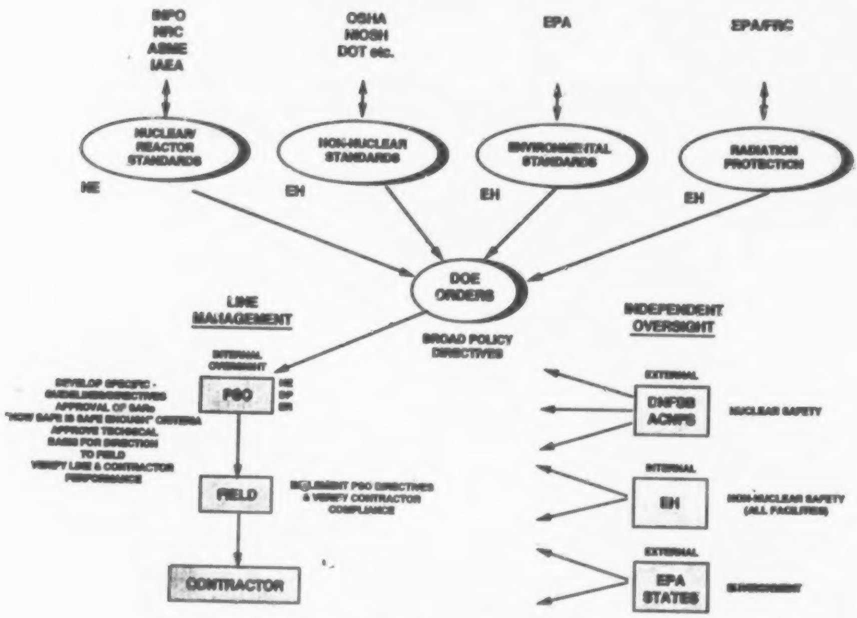
INTERPRETS POLICY
EH
FIELD
PROVIDES GUIDELINES & DIRECTION TO CONTRACTOR; APPROVES EXEMPTIONS; APPROVES RAP's; SETS PRODUCTION QUOTA.
VERIFIES CONTRACTOR COMPLIANCE (TSA) W/SAFETY REQUIREMENTS
CONTRACTOR
EXTERNAL OVERSIGHT
ACNFS
ADVICE & RECOMMENDATIONS
INTERNAL OVERSIGHT
EH
EXTERNAL OVERSIGHT
EPA STATES
ENFORCEMENT

PROPOSED REALIGNMENT


INPO
NRC
ASME
IAEA
OSHA
NIOSH
DOT etc.
EPA
EPA/FRC
NUCLEAR REACTOR STANDARDS
NON-NUCLEAR STANDARDS
ENVIRONMENTAL STANDARDS
RADIATION PROTECTION
NE
EH
EH
EH
DOE ORDERS
LINE MANAGEMENT
BROAD POLICY DIRECTIVES
INDEPENDENT OVERSIGHT
INTERNAL OVERSIGHT
PSO
NE
DP
ER
DEVELOP SPECIFIC - GUIDELINES/DIRECTIVES
APPROVAL OF SARs
"HOW SAFE IS SAFE ENOUGH" CRITERIA
APPROVE TECHNICAL BASIS FOR DIRECTION TO FIELD
VERIFY LINE & CONTRACTOR PERFORMANCE
FIELD
IMPLEMENT PSO DIRECTIVES & VERIFY CONTRACTOR COMPLIANCE
CONTRACTOR
EXTERNAL
DNFSB
ACNFS
NUCLEAR SAFETY
INTERNAL
EH
NON-NUCLEAR SAFETY (ALL FACILITIES)
EXTERNAL
EPA
STATES
ENFORCEMENT

NPR COST ESTIMATES

Senator Exon. The independent evaluation team that reviewed the cost estimates for the NPR program projected that NPR acquisition costs would rise by approximately 87 percent over the life of the project. The Congressional Budget Office has also confirmed the validity of these cost factors. Applying these projections would bring the cost of the NPR program to approximately $12 billion, almost twice the current cost. Are you prepared to review and revise the acquisition costs for this program and to take this into account in preparing your plan for modernizing the nuclear weapons complex?

Secretary Watkins. The Department is aware of the various reviews that have been done concerning the NPR program cost estimates. The current cost estimate of $6.8 billion in fiscal year 1988 dollars was derived using proponent-provided data. The fiscal year 1989 budget provides for the start of conceptual design and it is when this phase of the program is complete that a budget-quality total estimated cost will be available. As I have stated previously, all aspects of the NPR program will be thoroughly reviewed. When this effort has been completed, my findings, including revised cost estimates, will be shared with you.

WEAPONS ACTIVITIES

Senator Exon. Is the tritium contained in the tactical nuclear weapons that the Navy has recently announced it will retire (ASROC, SUBROC, and Terrier) already included in the current assessment of the tritium stockpile or do these retirements provide additional sources of tritium? When will the tritium from these warheads re-enter the pipeline?

Secretary Watkins. Yes, the current tritium assessment accounts for recovered tritium from these warheads. Retirement and disposal actions for these warheads have already started and recovered tritium is being returned to the pipeline.

Senator Exon. How much has DOE and its predecessor agencies spent on developing and producing nuclear weapons? Please provide the yearly amounts in current and constant (fiscal year 1990) dollars. If applicable, explain the basis for the increasing unit costs of weapons development and production.

Secretary **Watkins**. Following is a table which lists the amount spent on developing and producing nuclear weapons from fiscal year 1960 through fiscal year 1989 and our request for fiscal year 1990.

COSTS FOR DEVELOPMENT AND PRODUCTION OF NUCLEAR WEAPONS

[In millions of dollars]

Year	Total current dollars	Total constant dollars
1960	901	3,934
1961	906	3,920
1962	1,058	4,542
1963	1,135	4,789
1964	1,134	4,723
1965	1,066	4,385
1966	987	3,946
1967	983	3,813
1968	1,112	4,135
1969	1,286	4,546
1970	1,170	3,901
1971	1,138	3,636
1972	1,157	3,583
1973	1,209	3,524
1974	1,134	2,976
1975	1,126	2,708
1976	1,284	2,919
1977	1,461	3,122
1978	1,713	3,399
1979	1,989	3,545
1980	2,318	3,639
1981	2,938	4,179
1982	3,902	5,231
1983	4,634	6,026
1984	5,288	6,593
1985	5,961	7,174
1986	6,126	7,233
1987	6,026	6,864
1988	6,033	6,600
1989 estimate	6,247	6,535
1990 estimate [1]	6,852	6,852
Total	80,274	142,972

[1] Final fiscal year 1990 figures pending congressional action.

The unit cost of weapns development and production can change for a number of reasons. But principally, unit cost changes are driven by the military requirement or the introduction of new technologies to improve weapons reliability, safety, command and control, and security.

Senator **Exon**. What warheads are currently in inactive reserve? Please provide the amounts of nuclear material (tritium, plutonium, and uranium) they contain by warhead type and overall.

Secretary **Watkins**. [Deleted.]

Senator **Exon**. Please provide a list of the warheads being retired in fiscal year 1989, and the schedule for retirements in fiscal year 1990 and fiscal year 1991 and identify the quantities of tritium, plutonium, and uranium contained in these warheads.

Secretary **Watkins**. [Deleted.]

Senator **Exon**. What is the current status of the W84 Pershing II warhead and the W85 GLCM warhead? Has the tritium from these warheads been returned to the stockpile? What quantity of tritium do they contain? Are these warheads a candidate for the Follow-On-To Lance (FOTL) missile? Under what circumstances would one of these warheads not be modified for the FOTL? What modifications would be required? What is the justification for constructing new production facilities for a FOTL warhead?

Secretary **Watkins**. [Deleted.]

INERTIAL FUSION

Senator EXON. Please describe the budget for each laboratory and facility in the inertial confinement fusion (ICF) program for fiscal years 1986–1990.

Secretary WATKINS.

BUDGET FOR EACH ICF LABORATORY/FACILITY

[In millions of dollars] [1]

	Fiscal year—				
	1986	1987	1988	1989	1990 [2]
Laboratory:					
LLNL	66.7	67.6	68.8	67.8	74.3
Nova					
Halite/Centurion					
LANL	32.2	33.1	30.7	31.5	34.6
Aurora					
Centurion/Halite					
SNL	23.4	24.0	29.5	27.6	30.3
PBFA II					
KMSF	13.5	14.0	14.4	17.5	15.3
Target Fabrication					
UR	7.7	8.0	10.2	12.9	8.7
Omega					
NRL	2.8	3.8	3.8	4.8	4.0
Nike					

[1] Includes operating plus capital.

[2] President's budget.

Senator EXON. Specifically describe program plans by individual laboratory and facility for fiscal year 1990.

Secretary WATKINS. Program plans, by laboratory and facility, for fiscal year 1990 are:

Lawrence Livermore National Laboratory

Nova experiments supporting the weapon physics program and development decision for a Laboratory Microfusion Facility (LMF).

Solid state laser development supporting the LMF driver selection.

Design and development of candidate LMF targets.

Los Alamos National Laboratory

Aurora experiments supporting target development and weapon physics as well as development of krypton fluoride laser technology as a candidate for the LMF driver.

Development efforts supporting a future Centurion test.

Sandia National Laboratories

Target experiments for PBFA II accelerator and target development.

PBFA II experiments supporting LMF driver selection.

KMS Fusion, Inc.

Target component development and fabrication and some diagnostics development in support of ICF laboratories' experimental programs.

University of Rochester Laboratory for Laser Energetics

Continue Omega Laboratory experiments investigating direct drive as an option for long-term energy applications of inertial fusion.

Naval Research Laboratory

Develop krypton fluoride laser technology for Nike direct drive laser.

Senator EXON. Please describe the impact on the ICF program during fiscal year 1989 of reduced funding for the national laboratories and of the impact in fiscal year 1990 should that trend continue.

Secretary WATKINS. The budget recommendation of the 1985 National Academy of Sciences (NAS) review of the ICF program was to maintain the program at $155 million (operating) annual level of effort for the five-year period (fiscal years 1986–1990) to assess the feasibility of inertial fusion concepts. Overall programmatic priorities have not allowed maintenance of level of effort. Increasing the support laboratories' portion of the ICF budget has compounded the impact of this austere funding level. The major impacts have been on two of the three highest priority program elements identified by the NAS: Centurion at LANL and the NOVA laser physics experiments at LLNL. Other program objectives have been delayed or deferred. Additional reductions in fiscal year 1990 from the President's budget request would require further delays and cancellation of essential activities.

Senator EXON. What are the priorities for the ICF program that are not presently funded?

Secretary WATKINS. The near term goal for the ICF program is to position the U.S. to build a high-gain Laboratory Microfusion Facility (LMF) near the turn of the century, with a mid-90s construction decision required. To make a mid-90s decision with good technical confidence, an enhanced physics program at present facilities and a new initiative to develop and demonstrate the driver technology for an LMF are the priorities. These priorities are not currently funded. Specific projects include:

Enhanced Physics Program

Precision NOVA: Increase NOVA's on-target energy, shot rate, and diagnostics resolution (temporal & spatial).

NOVA Cryogenic Target Capability.

Beam Smoothing and ¼-Micron capability on NOVA.

Additional beam and target diagnostics for HERMES III (Sandia).

Advanced Centurion schedule to provide data for LMF capsule design.

Driver Technology Initiative

Complete the physics, technology, and cost data base for advanced solid state laser designs for a glass laser LMF module.

Develop HERMES III as a pre-prototype for a light ion LMF driver.

Develop the potential for low-cost, high-performance, KrF gas laser amplifiers and optics as a basis for upgrading Aurora.

PRIORITIES

Senator EXON. Is ensuring a safe and adequate source of tritium and the capacity to recycle existing supplies of weapons-grade plutonium a higher priority than building new facilities to provide new sources of plutonium and highly-enriched uranium?

Secretary WATKINS. Yes. The ability to support the existing and fielded nuclear stockpile requires a safe and adequate source of tritium. A basic production capability requires at least the ability to recycle plutonium for reuse in meeting minimal new production weapons requirements.

FERNALD

Senator EXON. The modernization study recommends closing the Feed Materials Production Center (FMPC) in Fernald, Ohio. When will a closure date and cleanup schedule for this facility be established and announced? Please describe the steps that are being taken to qualify domestic commercial producers for production of uranium metal to meet DOE's needs. Please describe the total funding required for the FMPC in fiscal year 1990 in terms of operating and construction funds and the justification for such funding. If applicable, please explain why funds are being requested to modernize the FMPC.

Secretary WATKINS. A vendor qualification program task force is established with representatives from DOE and contractor organizations. The final draft qualification program plan has been issued and is undergoing review. The forecast date to qualify vendor(s) is late in calendar year 1991. Metal production capability at FMPC will be shut down upon successful completion of the vendor qualification program and delivery of first product. A June 26, 1989, memo directed that consideration be given to preproduction of metal in fiscal year 1990 and cessation of metal production at FMPC at the end of fiscal year 1990. However, no funds were identified for preproduction in fiscal year 1990. Other programs, such as residue processing, will continue into the mid-1990s. A detailed study is underway to consider all issues and concerns related to production shutdown, such as National Environmental Policy Act requirements, other legal requirements, and nuclear materials disposition.

Environmental remediation activities will continue for several years. Nuclear materials production operating and equipment funding is $97.2 million in fiscal year

1990, compared to $91.3 million appropriated in fiscal year 1989. The fiscal year 1990 level of funding is required to produce uranium metal components for Y-12 and Rocky Flats fiscal year 1990 requirements; environmental, radiological and safety actions such as monitoring, engineering for environmental controls and exposure reduction; site maintenance; waste processing; preliminary engineering; and warehousing.

Defense waste operating and equipment funding is $38.6 million in fiscal year 1990. This funding will provide for the processing and shipping of backlog wastes offsite; interim remedial actions; completion or remedial investigations for four operable units; and completion of feasibility studies for two operable units.

Construction funding is $80.1 million in fiscal year 1990. This funding will primarily provide for environmental, health, and safety improvements. These improvements are required regardless of the future production mission at the site and several are mandated by consent decrees and compliance agreements. These include controlled storage pads, analytical laboratory, storm sewer improvements, and waste water treatment. Funding is provided to complete some modernization projects which are already well underway and are needed to meet mission requirements through the early 1990s. These include derby breakout facility, slag milling system, and a new automated furnace. Other projects which are underway will be completed because they are necessary to support FMPC's residue recovery program. These include crusher system, nitric acid recovery, and plant sumps. All FMPC projects are being closely evaluated to determine if they can be cost-effectively terminated in light of the current plans to discontinue metal production upon successful completion of the vendor qualification program for depleted uranium. Funding will also be provided for a complement of general plant projects to ensure continued safe operation of the plant in the areas of health, safety, environment, safeguards, and security.

QUESTIONS SUBMITTED BY SENATOR CARL LEVIN

PROPOSED NEW PRODUCTION REACTORS

Senator LEVIN. What would be the approximate annual tritium production capacity of each of the proposed new production reactors?

Secretary WATKINS. [Deleted.]

Senator LEVIN. Approximately what percent of tritium required to maintain our current arsenal would each of the proposed new production reactors produce?

Secretary WATKINS. [Deleted.]

Senator LEVIN. Approximately what percent of tritium required to maintain the START structure tentatively agreed to by the Reagan administration would each of the proposed reactors produce?

Secretary WATKINS. [Deleted.]

Senator LEVIN. What is the current DOE assessment of the accelerator production of Tritium (APT)?

Secretary WATKINS. The Department of Energy has reviewed the use of accelerators to produce tritium several times over the past ten years. The Energy Research Advisory Board Panel on New Production Reactor Technology recently evaluated the concept of the APT. The panel concluded that accelerator technologies for this purpose were not sufficiently mature to make a deployment decision at this time.

Reports by the Los Alamos National Laboratory and the Brookhaven National Laboratory on advanced APT concepts have recently been transmitted to the DOE. In addition, the Sandia National Laboratory is studying a new APT concept using a different type of accelerator. The Department is now planning a thorough review of these reports.

Preliminary information indicates that the laboratories that prepared the report believe that the concept of using an accelerator to produce tritium needs further development. Estimates have been made that it will require about four years and $250 million to develop the engineering aspects of an integrated facility concept (major component design and reliability assessments). Another consideration in APT is the provision of a power source in the order of at least 800 megawatts to power the accelerator. After the review, we will be better positioned to evaluate the feasibility of applying the method for reliable production of goal quantities of tritium. Their preliminary report will be submitted to DOE soon. The authors of the reports on APT concepts support the DOE decision regarding construction of reactor-based production as the lowest technical risk approach for supplying tritium currently available.

QUESTIONS SUBMITTED BY SENATOR STROM THURMOND

SPECIAL ISOTOPE SEPARATION PLANT

Senator THURMOND. In the current budget environment, the committee is likely to struggle over the priority we should attach to the Special Isotope Separation Plant, since there is no identified requirement today for the material that this facility would provide. How do you prioritize the Special Isotope Separation Plant in relationship to new production reactor capacity, Savannah River reactor restart, and waste management initiatives? Do you see any merit in offloading plutonium processing functions now performed at the Rocky Flats Plant to a modified Special Isotope Separation Plant?

Secretary WATKINS. As long as this Nation has a policy of nuclear deterrence, the DOE must maintain the capability to provide nuclear materials such as tritium and plutonium. Simultaneously, these materials must be produced in a safe and environmentally sound manner. To meet this objective, the Secretary has a definitive, priority-driven, well-costed, five-year waste management plan for DOE wastes, coupled closely to the latest available technologies in order to minimize cost and maximize efficiency.

The Savannah River Plant (SRP) restart represents our only existing capability to produce material. Assuming the requirements for safe and environmentally sound production are achieved, SRP has the most immediate priority. This priority is followed closely by the New Production Reactor (NRP) mission to provide an assured source of tritium necessary to sustain the viability of our existing nuclear deterrent. Considering the tritium burden on the existing producton capability, the SIS facility likely represents this Nation's only source of new weapon-grade plutonium until full NPR deployment beyond 2005. It thus provides a prudent level of contingency for meeting weapon grade plutonium requirements arising from potential increases in demand or disruption in the ongoing recovery of existing material. Thus, in addition to SRP restart, both the NPR and SIS capability must be initiated now to ensure a long-term reliable capability to produce and maintain reserves of materials for the Nation's defense. Likewise, waste management and environmental restoration programs must also proceed with emphasis commensurate with our responsibility to the public and the environment.

Plutonium processing and scrap recovery operations are performed in aging and increasingly unreliable facilities. The SIS facility has a significant balance of plant plutonium processing capability that could supplement or backup on-going Rocky Flat operations should this become necessary. However, it is highly desirable to proceed with the Building 371 modifications at Rocky Flats to maintain current on-site processing capability and perform the site cleanup operations associated with the eventual decommissioning of the Rocky Flats site.

NUCLEAR WEAPONS-RELATED RESEARCH

Senator THURMOND. Over the past several years budget trends indicated that the core programs related to nuclear weapons-related research have declined in real terms at Livermore, Los Alamos, and Sandia. Do you see these trends continuing, and do you view the increasing use of these laboratories for non-defense work as detracting from their national security function?

Secretary WATKINS. Between fiscal years 1984–1991, the budget for core programs related to nuclear weapons research decreased almost 20 percent in terms of constant dollars. This declining trend has been steady for several years and, under current budgetary constraints, is likely to continue.

The participation by DOE weapons laboratories in non-defense work and defense related work for others demonstrates the range of capabilities residing in these facilities. In principle, some participation in non-nuclear defense work would provide synergistic benefits to the laboratories and to the Nation. However, we are constantly alert to the concern that the increasing use of DOE for non-defense work will distract the laboratories from their primary mission.

The technical strength of the DOE laboratories was developed through the stability of long-term support by the DOE weapons program and constant focusing on the main mission. We are, therefore, concerned that the combined effect of the erosion of core research programs for weapons research and increased non-defense work at the DOE laboratories will dilute their technical strength and ultimately deprive the Nation of capabilities without counterpart in either the federal or private sector.

RESTORATION AND WASTE CLEANUP

Senator THURMOND. I strongly endorse your efforts to "institutionalize" environmental restoration and waste cleanup, and your appointment of Leo Duffy. How will these activities interact and relate to the Assistant Secretary for Defense Programs?

Senator WATKINS. Mr. Leo Duffy and the Acting Assistant Secretary for Defense Programs, Mr. Troy Wade, are working closely together to address the DOE's major environmental concerns. The position of Special Assistant for Coordination of DOE Defense Waste Management has been established to coordinate the responsibility for all of the Department's waste management, environmental restoration, and cleanup activities, and to have direct responsibility for defense waste management. Mr. Leo Duffy has been appointed to serve in this capacity and one of his first duties is to prepare an integrated DOE Environmental Restoration and Waste Management Five Year Plan. Additionally, Mr. Duffy has recently been assigned responsibility for coordinating all of the clean-up actions associated with nuclear or toxic wastes at the Savannah River site.

The Office of the Assistant Secretary for Defense Programs (ASDP) has line management responsibility and accountability for all facets of DP operation, including the assurance of environmental compliance. Consistent with this broad base of operational responsibilities, the ASDP also has line management responsibility and accountability for implementation of those Defense Programs projects and initiatives that will emerge from the environmental restoration and waste management planning effort.

Finally, a team of senior DOE staff and advisors have been directed to assess DOE organizational roles and responsibilities and to formulate recommendations that would improve operations. It is not clear at this time what changes in the current responsibilities of either Mr. Duffy or the ASDP (and how these two interact and relate to one another) may be proposed as a result of this assessment.

TECHNOLOGY COMPETITIVENESS

Senator THURMOND. In the past, both the executive and legislative branches have been rather reluctant to transfer technologies that arose out of the nuclear weapons program for reasons of national security. How do you propose to balance the requirements for national technological competitiveness and the requirements to protect information with a direct bearing on national security?

Senator WATKINS. Technology transfer from the weapons complex will be conducted in a manner that complements our national security mission and our technology security programs. This will be accomplished by building on the existing classification, export control, and security infrastructures at both headquarters and field levels. While we must uphold our legitimate technology security interests, "balance" is the key word. A strong industrial sector and healthy domestic economy are essential components of our national security. When the results of defense R&D can be further utilized to enhance these components, then it is critical to the national security that we do so.

To ensure that security requirements receive proper consideration, responsibility for technology transfer from the weapons complex has been placed with the recently created Office of Classification and Technology Policy (OCTP) within Defense Programs (DP). OCTP is the Department's principal policy arm for technology security and the technology transfer effort is staffed by persons possessing strong technology security credentials. DP is currently enhancing the security infrastructure for this effort in the field and preparing guidelines and procedures that will provide each facility with the security expertise necessary to conduct technology transfer responsibly.

MANAGEMENT LINES OF AUTHORITY

Senator THURMOND. Will you detail for the committee the authority you need from this committee to insert new management lines of authority within DOE?

Secretary WATKINS. As noted in previous hearings before Congress, I have had the Deputy Secretary and the Under Secretary conduct an extensive review of the organizational structure and management practices throughout the Department.

Actions which I am now taking are intended to make line organizations fully responsible for their own activities and are fully within my authority under the Department of Energy Organization Act. After I have had an opportunity to evaluate the results of the Deputy Secretary/Under Secretary review of organization structure and management practices, I will be in a better position to detail for the committee any additional authority which I believe is needed.

There are, however, certain legislative constraints which limit my authority to act on the basis of priorities. These include the following:

(1) There are staffing allocations for the Federal Energy Regulatory Commission, Office of Inspector General, and Power Marketing Administrations within the overall departmental allocations which limit the Secretary's ability to redeploy staff within the Department.

(2) There are congressionally established staffing "floors" for certain offices, i.e., Fossil Energy and Conservation programs, which must be maintained.

(3) The Offices of Alcohol Fuels, Minority Economic Impact, Subseabed Disposal Research, and Economic Regulatory Administration are examples of offices established statutorily which cannot be abolished or modified administratively.

(4) The Department is statutorily prohibited from soliciting or drafting proposals, or preparing or reviewing studies that would transfer Federal ownership or control of the Power Marketing Administrations (except Alaska Power Administration). Similar legislation is pending in Congress with respect to the Naval Petroleum Reserves.

QUESTIONS SUBMITTED BY SENATOR JOHN McCAIN

CHEMICAL WARFARE VERIFICATION

Senator McCAIN. Could you describe the role you feel that DOE should play in arms control research on the verification of chemical weapons treaties?

Secretary WATKINS. We believe that the DOE can provide assistance in chemical weapon arms control research through the use of the technical expertise at the DOE national laboratories. The DOE expects to remain in the R&D arena, with operational test and evaluation more appropriately the responsibility of other organizations.

Senator McCAIN. Would this involve any shift in the allocation of resources away from the Army and DOD to DOE?

Secretary WATKINS. At the present time, it is unlikely that any funds would be shifted from the Army and DOD for chemical weapons verification.

Senator McCAIN. Why is DOE seeking to expand its role in an area where the Army has taken the lead in past years?

Secretary WATKINS. The DOE is not seeking to expand its role in chemical warfare technology where the Army has the lead in battlefield activities, but is making the expertise of the DOE national laboratories available at the national level in the area of research and development for treaty verification. The DOE is cooperating with DOD in developing arms control verification technologies through R&D, with DOD managing tests, evaluations, and implementation.

Senator McCAIN. What special capabilities does the DOE have that justify a major new research effort?

Secretary WATKINS. The DOE has the technology base developed at the national laboratories over the past four decades. Research and development of verification technologies for chemical weapons is an important activity in support of international negotiations on arms control, but the DOE does not consider it to be a major new research effort at the national laboratories.

[Whereupon, at 4:11 p.m., the hearing was adjourned.]

DEPARTMENT OF DEFENSE AUTHORIZATION FOR APPROPRIATIONS FOR FISCAL YEARS 1990 AND 1991

WEDNESDAY, JUNE 14, 1989

U.S. SENATE,
COMMITTEE ON ARMED SERVICES,
Washington, DC.

BALANCED TECHNOLOGY INITIATIVE AND INTERNATIONAL ARMAMENTS COOPERATION

The committee met in open session, pursuant to notice, at 2:05 p.m. in room SR–222, Russell Senate Office Building, Senator Sam Nunn (chairman) presiding.

Committee members present: Senators Nunn, Exon, Levin, Bingaman, Dixon, Warner, Thurmond, Cohen, and Gorton.

Committee staff members present: Arnold L. Punaro, staff director; Andrew S. Effron, general counsel; Kathryn E. Bognovitz, special assistant; and Daniel Sakura, research assistant.

Professional staff members present: Richard E. Combs, Jr., Richard D. Finn, Jr., William E. Hoehn, Jr., T. Kirk McConnell, and William H. Smith.

Minority staff members present: Romie L. Brownlee, deputy staff director for the minority; Judith A. Freedman and George W. Lauffer, professional staff members.

Staff assistants present: Barbara L. Braucht, Barbara Gallo, Lori M. Jackson, and Debra A. Rice.

Committee members' assistants present: Jeffrey B. Subko, assistant to Senator Exon; Kenneth N. Luongo, assistant to Senator Levin; William J. Lynn, assistant to Senator Kennedy; Edward M. McGaffigan, Jr., assistant to Senator Bingaman; James M. Bodner, assistant to Senator Cohen; Dudley L. Carlson, assistant to Senator Wilson; Anthony H. Cordesman, assistant to Senator McCain; Robert M. Soofer, assistant to Senator Gorton; Charles G. Pearcy, assistant to Senator Lott; and Eric H. Thoemmes, assistant to Senator Coats.

OPENING STATEMENT OF SENATOR SAM NUNN, CHAIRMAN

Chairman NUNN. The committee will come to order. The Armed Services Committee meets this afternoon to conduct a hearing on the Balanced Technology Initiative as well as international armaments cooperation.

This committee created the Balanced Technology Initiative in 1986 to finance promising new technologies that could substantially advance our conventional defense capabilities or that could leapfrog areas of Soviet advantages.

In 1987 the Department of Defense provided a plan for undertaking 44 original projects selected out of the hundreds of ideas submitted by the military services as well as DARPA.

In addition, the Department subsequently identified 15 new programs to add to the original 44 and it is my understanding that most of these projects will continue today. We will be interested in the Department's report on their accomplishments and we will hear from Dr. Duncan on that.

The committee received testimony from our witness this afternoon, Dr. Cliff Duncan, on the BTI programs last year in April. In his testimony last April Dr. Duncan noted that he had become a strong supporter of the BTI concept following his in-depth review of all parts of the program.

He also identified in his testimony several critical needs to make the program stronger. The committee is anxious to hear this afternoon whether that support that Dr. Duncan indicated last year continues now and what he believes has been accomplished in fulfilling the needs he previously described.

The Defense Department's proposed funding for BTI in fiscal years 1990 and 1991 is less than 50 percent of what was called for in the program submitted by the Department of Defense nearly 2 years ago.

Of course, the whole budget comes down. No doubt about that. This request being reduced, however, raises questions about the ability of the Department to execute the program as it is presently planned and the committee certainly wants to review that today.

The second focus of today's hearing is international armaments cooperation. For most of its 40-year history the NATO alliance has suffered from what defense expert Tom Callahan has described as structural disarmament. The result is a collection of military forces that in large part duplicate one another in their equipment and risk serious gaps in their conventional capabilities.

Early in this decade, it became clear that the United States and its NATO allies would have to cooperate in equipping their forces if they hoped to avoid a complete reliance on nuclear weapons.

A principal vehicle that has emerged for this armaments cooperation and collaboration is the Cooperative Research and Development program. Since this committee initiated the program in 1985 it has strongly supported a consistent, stable level of funding for the program's implementation.

The Defense Department's request for fiscal years 1990 and 1991 is less than one half of that historical level so we will not address this funding question in today's hearing. In addition, I expect the committee will raise some of the broader questions that bear on the future of armaments cooperation.

For example, has the problem of what has been called structural disarmament gotten worse or better during these last 10 years? How effective has armaments cooperation been in resolving this complicated and challenging problem.

What criteria should govern cooperation with defense allies who are also economic competitors? What are the implications of the

European Community's plan to create a single, integrated market in 1992?

To help us answer questions like these about the Balanced Technology Initiative and armaments cooperation, the committee will receive testimony today from two officials of the Department of Defense.

We would like to welcome Dr. Cliff Duncan, the Director of Defense Research and Engineering, and Mr. Jim Compton, the Assistant Deputy Under Secretary of Defense for Industrial and International Programs. We appreciate both of you testifying at today's hearings.

Before we ask for your testimony I will defer to Senator Warner for any opening statement. Senator Warner.

Senator WARNER. Thank you, Mr. Chairman. I have been privileged to work right along in full partnership with you on these issues and I think you covered in your opening statement the great significance and importance to this committee and to the Senate as a whole—to our country.

Chairman NUNN. Thank you very much, Senator Warner. Any other opening statements today?

Senator DIXON. I will put one in the record, Mr. Chairman, if I may.

Chairman NUNN. By all means, it will be incorporated.

[The prepared statement of Senator Dixon follows:]

PREPARED STATEMENT BY SENATOR ALAN J. DIXON

I welcome our distinguished witnesses who are here today to testify on the current status of the Balanced Technology Initiative (BTI) Program and international armaments cooperation.

Despite the potential drawdown of both NATO and Warsaw Pact forces in Europe, the BTI Program continues to be an important element in our attempt to reduce the numerical imbalance of forces that still exists in Europe and are likely to exist on any future battlefield. We should continue to exploit our technological edge over the Eastern bloc, particularly as it pertains to improving our anti-armor and close air support capabilities. I am delighted that this program is focusing on these two specific areas, as well as others. Unfortunately, this program cannot be fully funded because of strict budgetary constraints, but I hope we can adequately fund the most promising projects.

Where feasible, balanced technology initiative projects should be incorporated into cooperative programs with our allies, particularly our NATO allies. We are confronted by a common threat and are faced with zero-growth defense budgets for the foreseeable future. Cooperative armaments programs constructed within a viable strategy could save scarce defense dollars, reduce redundancy, and focus efforts to address major deficiencies in our military capability. Cooperative efforts can be beneficial to our defense industrial base, but only if each cooperating party is contributing significantly to the effort. A one-way U.S. giveaway of our technology is not in our long-term best interest. We also have to ensure that our technology safeguards are adequate to prevent our adversaries from obtaining critical military technology, as they did in the Toshiba-Kongsberg incident.

The Balanced Technology Initiative Program and international armaments cooperative programs are promising efforts that will help us meet the challenges we face. We have two distinguished witnesses here today to tell us more about these programs and I look forward to their testimony.

Chairman NUNN. Senator Bingaman I know you have been very involved in this whole area. Do you have anything you would like to say?

Senator BINGAMAN. Mr. Chairman, I will put a formal statement in the record. I do have a series of questions after the witnesses have made their presentation about how this Balanced Technology Initiative fits in with some of the other things that they are also pursuing in the Department of Defense.

[The prepared statement of Senator Bingaman follows:]

Prepared Statement by Senator Jeff Bingaman

Thank you Mr. Chairman. The strength of the United States national security has been achieved, in large part, on the ability of our scientists and engineers to lead the world in applying advanced technology to our defense systems. Recently, President Bush has presented the Soviets with a negotiating position that could lead to a significant reduction of conventional forces in Europe. I applaud his initiative and hope that it can lead to a reduction of tension between East and West. None of this should be used as an excuse, however, for the United States to reduce our support of long-term science and technology programs performed in support of national security.

This committee has a long record in promoting the defense technology base. The Balanced Technology Initiative is one important element of that technology base. But there are many other programs and projects that contribute to maintaining our science and engineering leadership. For example, last year this committee requested the Department's plan for developing Critical Technologies; the top 20 or so technology areas that we should pursue as a nation to maintain our long-term leadership in defense technology. We have received that plan and have reviewed it carefully. Based on that review I plan to introduce additional legislation in this year's markup. We need to ensure that related efforts such as the Balanced Technology Initiative and the Critical Technologies programs are conducted in a thoroughly integrated and coordinated manner.

While I was an original cosponsor and remain a strong supporter of the Balanced Technology Initiative, I also have a number of serious concerns about the program. I am concerned that the program lacks sufficient focus to achieve what was originally intended. I am concerned that the BTI Program, like many others in the Department of Defense, suffers from lack of a top level Department Science and Technology Strategic Plan and associated investment strategy. And I remain concerned that we still do not know how to effectively transition the products of our technology developments into the field. While programs such as BTI can, and will, continue to contribute to maintaining our strong national defense, it is important that we address some of these other problems in order to receive an even greater return on investment for our dollars. I will explore at this hearing whether we shouldn't use the BTI as a mechanism for inserting the identified 22 critical technologies into weapon systems in important conventional mission areas, such as armor/antiarmor.

These are busy, turbulent days for the leadership of the Department as they simultaneously take up the defense leadership responsibilities under the Bush administration and deal with difficult policy issues in a rapidly changing world. Nevertheless, I must urge them to take a strong and direct role in defining the policies and assuring the speechment of the defense technology base programs. These programs are, and will remain, essential to our future security.

Chairman NUNN. Senator Exon.

Senator EXON. Mr. Chairman, I would just like to say that I think this is a particularly timely hearing and I congratulate you for calling it. We are going to have several members of the committee in and out today with other assignments but I thank the panel for being here because this is going to be a great deal of guidance to us in this particularly important area.

Chairman NUNN. Thank you very much, Senator Exon.

Dr. Duncan, glad to have you, would you proceed.

STATEMENT OF HON. ROBERT C. DUNCAN, DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING, DEPARTMENT OF DEFENSE, ACCOMPANIED BY WILLIAM [illegible]. SNOWDEN, SPECIAL ASSISTANT TO THE DEPUTY DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING (RESEARCH AND ADVANCED TECHNOLOGY), AND STEVEN A. AUSTIN, ASSISTANT DEPUTY UNDER SECRETARY (PLANNING AND ANALYSIS)

Dr. DUNCAN. Thank you, Mr. Chairman. It is a pleasure to be here. I have a statement that I would like to enter into the record and I would like to summarize it in about 5 minutes or less if I may.

Chairman NUNN. Whatever time you need.

Dr. DUNCAN. In addition, as you indicated, Mr. Jim Compton sitting on my left will have a statement to make following mine and he will talk about the NATO initiatives—the so-called Nunn-Roth-Warner initiatives.

In addition to the two of us, we have two people I would like to introduce. One is Steve Austin, here, who handles for Mr. Compton the Nunn programs—the NATO programs—and Dr. Bill Snowden sitting behind me, who is the coordinator of all the Balanced Technology Initiative programs within DDR&E.

Chairman NUNN. We are glad to have all of you. Your whole statement will be part of the record without objection.

Dr. DUNCAN. Yes, sir. This program, as you indicated, was started by the 99th Congress to provide additional support for the development of promising new technologies that could substantially advance our conventional defense capabilities.

The program details were described in a comprehensive report to Congress which we submitted in May 1987 in this blue book which indicated the 48 initial programs that were undertaken.

The National Defense Authorization Act for fiscal years 1988 and 1989 directed that the BTI program be expanded to include new projects consistent with the overall program objectives. We did expand it with 15 new projects as you indicated and submitted a second report dated April 1989—this is also a classified, secret report—to this committee.

BTI is a technology development and demonstration program constructed to make a difference in a few technology areas considered critical to the successful execution of conventional defense missions.

In the legislation, over a period of 2 years that identified and called out this program, there were eight areas that were highlighted as being areas on which we should concentrate. We have actually done work in seven of those eight but three-fourths of the work is concentrated into three areas: smart weapons technology, what we call RSTA/BMC ^{3} technology—that stands for reconnaissance, surveillance, target acquisition, battle management, C3I which is a large category. Third, armor/anti-armor technology.

We also have programs going in high powered microwaves and the fifth category is called special technology opportunities. It is kind of a catch-all for those programs that are not identified with any of these major focuses, and there are only a few programs there. I would like to talk about each of the areas very, very briefly.

Smart weapons technology category: our work is accelerating technology critical to the development of advanced fire-and-forget weapons, autonomous weapons useful against numerous types of ground, air and sea targets.

The projects address a variety of issues related to advanced sensors and seekers, autonomous guidance, automatic target recognition, and the producibility of components for complex weapons systems so that we can hopefully make these weapons more affordable, more reliable, and more producible.

The second category, the RSTA/BMC[3] category, is advancing technology important in obtaining, processing, passing, and using information vital to overall force effectiveness. Ongoing projects include developments in the areas of surveillance and targeting as well as work related to information management.

In the armor/anti-armor area, we are trying to contribute to increased survivability and more lethal fire power for U.S. and allied conventional forces, primarily forces involved in ground combat. Most of the projects included in this category are complementary to the on-going efforts included in the joint DARPA, Marine Corps, Army armor/anti-armor program.

The BTI complementary programs include projects involving advanced guns and projectiles, new weapons concepts, mine-countermine warfare, and materials work.

The high-powered microwaves category was included in the original BTI plan in recognition of the potential importance of high-powered microwaves in future conventional conflicts. The principal objectives of the BTI supported work here are to develop a comprehensive, fundamental understanding of the effects of high-powered microwaves on a variety of tactical weapons systems, to evaluate hardening methods capable of promoting increased survivability for our assets, and to examine approaches for exploiting the potential vulnerabilities of enemy systems.

In the special technologies category, important conventional defense problems not readily identified with the other four are included. These include work related to tactical missile defense, tactical laser weapons, advanced power sources, and enabling technology for the next generation close air support aircraft.

I would like to take just a minute to talk about international cooperation, trying to tie the BTI together with the NATO programs. Congressional language in fiscal year 1989 said "a link should exist between the BTI and the NATO Cooperative Research and Development program to maximize alliance resources."

From the outset in our BTI program planning, we have had participation by those officials in the DOD responsible for executing the NATO Cooperative Research and Development program. Potential for international cooperation has been an important consideration in selecting new BTI projects and a number of the BTI projects in existence already involve cooperation with our allies—an example being the ASTOVL program.

With respect to funding, I have some brief comments. Funding for BTI work to date has provided adequate resources for development of a comprehensive, aggressive program. However, it is quite evident that in the present period of constrained resources, difficult decisions must be made regarding future funding of on-going projects.

The current budget request for the program is approximately $206 million in fiscal year 1990 and $201 million in fiscal year 1991. These figures fall far short of the funding profiles contained in the two reports we have submitted. Funding alternatives will have to be found for many of these projects.

We plan to review technical progress and programmatic issues for all of the on-going efforts near the end of this fiscal year. The highest priority, most promising projects will be identified for continued funding using BTI resources.

For additional high priority projects we will encourage the services to assume responsibility for continued funding. Certain projects will be subjected to funding reductions and some projects must be terminated.

In conclusion, I consider the BTI program to be an important element of the DOD science and technology program. Technology development and demonstration projects supported by BTI build on earlier science and technology program achievements and will help to accelerate transition into full-scale development.

BTI efforts have a positive influence on the scope and progress of related, on-going R&D activities. I believe the BTI program is making considerable progress toward its early stated objective to make a difference in advancing technologies important to the successful execution of conventional defense missions. Without your continued support, I am confident that progress can be maintained.

[The prepared statement of Dr. Duncan follows:]

PREPARED STATEMENT OF
DR. ROBERT C. DUNCAN
DIRECTOR DEFENSE RESEARCH AND ENGINEERING
DEPARTMENT OF DEFENSE

Introduction

I am pleased to be here this afternoon to review ongoing Department of Defense work on the Balanced Technology Initiative (BTI). As Director of Defense Research and Engineering, I have appeared before this committee on many occasions to discuss various aspects of our overall Research, Development, Test and Evaluation (RDT&E) program. In one of those appearances (April 1988), I described the BTI program in some detail and expressed my strong support for its important objectives. In my remarks today I want to reaffirm that support and inform you of recent program developments.

The Balanced Technology Initiative, which had its origins in this committee, was established in Fiscal Year 1987 by the 99th Congress to provide additional support for the development of "promising new technologies that could substantially advance our conventional defense capabilities." The program was intended to "expand research on innovative concepts and methods of enhancing conventional defense capabilities," and to promote "restoration of the conventional defense technology base." Program details were developed by technical and operational experts within the Department of Defense and described in a comprehensive report to Congress submitted in May 1987.

Continuing Congressional support for the BTI program was reflected in subsequent defense authorization and appropriations legislation. The National Defense Authorization Act for Fiscal Years 1988 and 1989 directed that the BTI program be expanded to include new projects consistent with overall program objectives.

This expansion was ultimately accomplished using reprogrammed FY 1988 RDT&E resources. Approval for this reprogramming action was provided in the Defense Appropriations Act for Fiscal Year 1989. A second BTI report to Congress was required by the National Defense Authorization Act for Fiscal Year 1989. This report, which described fifteen new projects recently added to the program, was submitted last month. The report outlined the program development process, provided information pertaining to milestones and funding required to maintain progress over a five-year period, and included funding data to date for the BTI projects initiated in Fiscal Year 1987.

Program Description

The Balanced Technology Initiative is a technology development and demonstration program structured to "make a difference" in a few technology areas considered critical to the successful execution of conventional defense missions. Specific projects involve work in five categories: (1) Smart Weapons Technology, (2) RSTA/BMC3 Technology (RSTA - for Reconnaissance, Surveillance, and Target Acquisition; BMC3 - for Battle Management, Communications, Command, and Control), (3) Armor/Anti-Armor Technology, (4) High Power Microwaves (HPM), and (5) Special Technology Opportunities. The present program consists of about 50 projects, including continuing work initiated late in Fiscal Year 1987 and the 15 new projects described in the most recent report to Congress.

BTI projects in the Smart Weapons Technology category are accelerating technological progress critical to the development of advanced fire-and-forget, autonomous weapons useful against numerous types of ground, sea, and air targets. Such weapons offer significant force-multiplier benefits for both short- and long-range attack of high-value enemy assets. The projects address a variety of issues related to advanced sensors and seekers, autonomous guidance and automatic target recognition (ATR), and the producibility of components for complex weapon systems. The sensors and seekers work will contribute to improvements for existing weapons (e.g., the MAVERICK anti-tank missile, by developing all-weather millimeter wave terminal homing capability) and also enable development of versatile new weapons. Work involving autonomous guidance and ATR will facilitate precision weapon delivery to selected enemy targets and provide new deep-attack capabilities that can help to reduce U.S. and Allied casualties. Significant progress is being made on one such project, which involves development of a novel concept for attacking a variety of lightly-armored, second-echelon targets. Smart weapons components efforts are concerned with affordability, manufacturability, and reliability issues. An example is ongoing work to develop monolithic focal plane arrays that offer significant cost and performance advantages for infrared sensors.

Four new projects have recently been added to the Smart Weapons Technology category to supplement ongoing work:

- Worldwide proliferation of sophisticated heat-seeking guided missiles represents a severe threat to U.S. aircraft engaged in low-altitude operations. The **Infrared Countermeasures Technology** project, a tri-Service effort, will develop and support in-flight demonstrations of a system able to negate this threat.
- Low cost, lightweight thermal imaging sensors have many important military applications. The **Uncooled Focal Plane Arrays** project will develop such sensors and demonstrate their use in field trials of advanced night sights, surveillance imagers, and low-cost day/night seekers for missiles and submunitions.
- Smart weapons must operate effectively under many types of battlefield conditions. The **Smart Weapons Operability Enhancement** project, which will involve cooperative work by all of the Services and DARPA, will contribute to improved performance over a wide range of operational environments, including variations in climate, weather, terrain, time of day, and certain battle-related phenomena.
- Marine Corps helicopters and fixed-wing aircraft supporting ground actions need effective self-defense capability

against enemy air defense units (ADUs) that have survived earlier ADU-suppression strikes. The **SIDEARM II Technology** project will develop and demonstrate significant new capabilities for the SIDEARM I missile that will increase effective range and enable attack of more types of air-defense radars.

BTI projects in the RSTA/BMC3 category are advancing technologies important in obtaining, processing, passing, and using information vital to overall force effectiveness. The projects include developments in the areas of surveillance and targeting, as well as work related to information management. Surveillance activities include expanded Navy efforts to detect and track enemy submarines using both active and passive acoustic techniques, and joint DARPA/Army work to locate and monitor important mobile ground targets. Targeting technology developments will allow for selective concentration of firepower and could lead to one-shot one-kill capabilities. For example, important progress has recently been demonstrated by the Navy in successful flight tests of a fiber-optic data link for air-launched weapons. Information management efforts will enhance rapid analysis of battlefield data and promote better coordination and synchronization of combat operations. One such project is developing new capabilities to automate important command and control functions for ground combat vehicles.

Four new projects have been added to the RSTA/BMC3 category:

- Battlefield intelligence staffs responsible for controlling a variety of intelligence collection assets and maintaining credible assessments of the dynamic battle situation operate under extreme time pressures. The **Artificial Intelligence Module** project will develop new means for automating many critical data analysis tasks that can be transitioned to the All Source Analysis System (ASAS) and other DoD intelligence programs.
- The demand for image-related intelligence information during battle or crisis situations can far exceed the rate at which trained experts are able to interpret the available raw imagery. The **Image Exploitation System** project, a joint Army/DARPA effort, will develop and demonstrate an advanced system for automated interpretation of battlefield imagery.

- Practice for senior commanders and their staffs in exercising coordinated decision skills under stress can be facilitated by use of simulation facilities sited at their normal duty stations. The **ACE Distributed Wargaming System** project will initiate development of a networked, corps-sited battle simulation system for Allied Command Europe.

- Effective future defense of carrier battle groups (CVBGs) will require destruction of enemy bombers at long range before anti-ship missiles can be launched. To enhance our ability to coordinate fleet air defense actions the **Advanced Airborne AAW Engagement System** project will develop and demonstrate an advanced narrow-beam, data-exchange communication and targeting system having improved anti-intercept and anti-jam features.

Projects in the Armor/Anti-Armor Technology category will contribute to increased survivability and more lethal firepower for U.S. and Allied conventional forces, primarily forces involved in ground combat. Most of the projects included in this category are complementary or supplementary to ongoing efforts included in the joint DARPA/Army/Marine Corps Armor/Anti-Armor Program. The BTI activities include projects involving advanced guns and projectiles, new weapons concepts, mine/countermine warfare, and materials/phenomenology/modelling. Development of advanced guns and projectiles will provide greater lethality against enemy armors. For example, recent program results have substantiated the significant performance potential of incorporating advanced composite materials in new gun designs, and notable progress is also being made in developing high-performance projectiles that utilize propulsion outside the gun tube. Projects involving advanced weapons concepts are investigating new ways to defeat a variety of land, sea, and air targets. One such project will improve the long-range accuracy of existing tank guns and enable the defeat of maneuvering airborne threats to ground combat vehicles. Mine/countermine work is supporting a number of exciting new technology development and demonstration efforts that could provide major improvements over present capabilities. One new approach for mine detection under investigation has shown great potential against a wide variety of mines (both scattered and buried, and metallic or non-metallic types). The materials/phenomenology/modelling work will accelerate the pace of advanced armor and munitions development. A comprehensive dynamic material behavior and computational mechanics effort will improve our ability to model impact-related phenomena important to the performance of advanced weapons and protection systems.

Three new projects have been added to the Armor/Anti-Armor Technology category:

- Major and continuing U.S. advances in armor and anti-armor capabilities are required to meet the ever-more-challenging Soviet/Warsaw Pact armor threat. The **Materials for Advanced Weapon Systems** project will accelerate development and fielding of several types of materials that offer important advantages for armor protection or munitions performance.
- New cruise missiles will provide precise weapon delivery at long range. To enhance the military potential of these weapons, the **Advanced Warheads for Conventional Cruise Missiles** project, a joint Navy/Air Force effort, will develop and demonstrate new blast-frag-reactive warhead concepts capable of providing greatly increased lethality against a wide variety of targets.
- Electrothermal (ET) guns offer a promising new approach for greatly increasing the velocity, range, and lethality of many types of large-caliber guns. The **Electrothermal Gun Technology** project will develop and demonstrate a field-portable, multi-shot ET gun to evaluate weaponization potential for both anti-tank and air-defense applications.

Work involving high power microwaves (HPM) was included in the original BTI program plan in recognition of the potential importance of HPM weapons in future conventional conflicts. Significant new technology-base efforts in five different areas were started to expand ongoing HPM work being conducted by all of the Services and the Defense Nuclear Agency (DNA). A well coordinated national program that includes these efforts is currently being executed under the direction of an HPM Program Implementation Panel comprised of numerous technical experts from within the Department of Defense and from the National

Laboratories. The principal objectives of BTI-supported activities are to develop a comprehensive fundamental understanding of the effects of HPM on a variety of tactical weapons systems, evaluate hardening methods capable of promoting increased survivability for U.S. and Allied assets, and examine approaches for exploiting potential vulnerabilities of enemy systems.

Based on recent advances in HPM technology, particularly involving energy sources, the Program Implementation Panel recommended that a single new project be initiated to accelerate U.S. developments in this area. The proposed project was critically reviewed and accepted. The new project, **HPM Technology Demonstration**, will accelerate the development and scaleup of laboratory-proven HPM source technologies to permit field demonstrations needed for future weaponization decisions.

Projects in the Special Technology Opportunities category address important conventional defense problems not readily identified with the four program thrust areas already described. These projects include work related to tactical missile defense, tactical laser weapons, advanced power sources, and enabling technology for next-generation close air support aircraft. One project initiated in late 1987 has recently been completed and shown great success. For the first time, a high energy laser system has successfully engaged and destroyed a supersonic tactical missile in flight.

Three new projects have been initiated in the Special Technology Opportunities category:

- Aircraft that can fly undetected through enemy-held and disputed territory are required for many missions executed by Special Operations Forces (SOF). The **Avionics for Clandestine Operations** project will develop and demonstrate an advanced avionics suite for SOF aircraft that will enable extended low-altitude flight and provide greatly enhanced radar- and SIGINT-avoidance capabilities.

- Effective battle-damage control is critical to the survival of close-air-support aircraft subjected to intense enemy counterfire during combat. The **AV-8B Survivability Enhancement** project will develop and demonstrate proven explosion-suppression and fire-fighting technologies for Marine Corps AV-8B attack aircraft.
- BTI program-planning flexibility and overall management effectiveness will be increased by activities carried out in the **Assessment of Advanced Concepts** project. Select short-duration tasks will be executed to establish the merits of potentially high-payoff future projects.

International Cooperation

Congressional language included in the National Defense Authorization Act for Fiscal Year 1989 states that "... a link should exist between BTI and the NATO Cooperative Research and Development program to maximize alliance resources..." Greater cooperation with our allies (in developing enabling technologies for future weapons systems) was urged. The NATO Cooperative Research and Development program was established to promote improved cooperation in the development and production of military equipment and munitions. I believe that cooperative technology development and demonstration efforts carried out as part of the BTI program, efforts which would represent an earlier step in the evolution of new military capabilities, could help to identify promising areas for subsequent joint systems development programs. Shared ownership of enabling technology might greatly facilitate startup and increase prospects for successful completion of new international efforts under the NATO Cooperative Research and Development program.

From the outset, BTI program planning has involved participation by DoD officials responsible for executing the NATO Cooperative Research and Development program. Potential for international cooperation has been an important consideration in selecting new BTI projects. A number of BTI projects already involve cooperation with our allies:

- The BTI/Army project **Combat Vehicle Command and Control** (CVC2) involves U.S. cooperation with The Federal Republic of Germany intended to promote interoperability between the M1A1 and Leopard II tanks through incorporation of CVC2 modules in both vehicles. An MOU, signed in 1988, provides for the information exchange needed to achieve interoperability. Discussions are underway that could result in the United Kingdom joining this effort.
- The BTI/DARPA project **ASTOVL Technology** extended work begun by the NATO Cooperative R/D program as a joint effort with the United Kingdom. This project is continuing under DARPA funding.
- The BTI/Army project **Electrothermal Gun Technology** is developing a promising new approach for greatly increasing the velocity, range, and lethality of many types of large caliber guns. A complementary project in this area, involving joint work with the Federal Republic of Germany, is being considered for funding under the NATO Cooperative R/D program.
- The BTI/Army project **Tactical Missile Interceptor Technology** includes work on interceptor guidance and warheads and on command and control for tactical missile defense (TMD). This project has facilitated development of an agreement with the Federal Republic of Germany for joint work on TMD; a memorandum of understanding (MOU) on the cooperative program is expected to be signed soon.
- The BTI/Marine Corps project **AV-8B Survivability Enhancement** is developing and demonstrating proven explosion-suppression and fire-fighting technologies for application to the Marine Corps AV-8B (Harrier) aircraft. Harrier aircraft for the Marine Corps are manufactured in the U.S. under an agreement with the United Kingdom.

Additional opportunities for cooperative technology development work with our allies are being sought. Visits by DoD officials to NATO headquarters and to SHAPE have explored possible approaches. Potential new areas for cooperation involving the United Kingdom will be discussed later this month with officials from the Ministry of Defence.

Program Funding

Funding for BTI work to date has provided adequate resources for development of a comprehensive, aggressive program. However, it is quite evident that in the present period of constrained resources difficult decisions must be made regarding future funding of many ongoing projects. The current budget request for the program is approximately $206 million in Fiscal Year 1990 and $201 million in Fiscal Year 1991. These figures fall far short of the funding profile totals contained in the two BTI reports to Congress. Funding alternatives will have to be found for many of the projects.

We plan to review technical progress and programmatic issues for all ongoing efforts near the end of this fiscal year. The highest priority, most promising projects will be identified for continued funding using appropriated BTI resources. For additional high priority projects we will encourage the Services to assume responsibility for continued funding. Certain additional projects may be subjected to funding reductions, and some projects must be terminated. For terminated projects, related work may continue as part of the Department of Defense Science and Technology program, subject to availability of resources.

Concluding Remarks

The Balanced Technology Initiative is an important element of the DoD Science and Technology program. Technology development and demonstration projects supported by BTI resources build on earlier Science and Technology program achievements and help to accelerate the transition of many emerging capabilities toward full scale development and into the field. BTI efforts have a positive influence on the scope and progress of related ongoing research and development activities. An additional benefit is that available BTI resources facilitate the timely initiation of research work in new areas and on novel concepts considered to offer great potential for enhancing U.S. military capabilities. I believe that the BTI program is making considerable progress toward its early stated objective to "make a difference" in advancing technologies important to the successful execution of conventional defense missions. With your continued support, I am confident that progress can be maintained.

Chairman NUNN. Thank you, Dr. Duncan. I think what we will do today is go ahead with Mr. Compton's testimony and then come back for questions. There are two different subjects. To some extent they may interrelate but they also are along the same lines. So Mr. Compton, we are delighted to have you and we will hear from you now.

STATEMENT OF JAMES M. COMPTON, ASSISTANT DEPUTY UNDER SECRETARY OF DEFENSE (INDUSTRIAL AND INTERNATIONAL PROGRAMS)

Mr. COMPTON. Thank you very much, Mr. Chairman and members of the committee. It is a particular pleasure for me to appear before you, my first appearance before this committee.

I would also like to take the opportunity to thank this committee for the support it has given to the international logistics projects that I have had the responsibility for over the past 9 years before I assumed my current position. You have helped us in a great many ways and I will mention one specific example later on in this statement.

I would like to have my prepared statement entered into the record with your permission, sir, and then briefly summarize the statement.

Chairman NUNN. Without objection.

Mr. COMPTON. This committee's support for international armaments cooperation is certainly longstanding. The Nunn-Roth-Warner amendment to the 1986 Defense Authorization Act has been extremely effective in reducing needless duplication of development efforts within the NATO alliance.

Since enactment of this legislation, the United States has undertaken 27 programs for international cooperative research and development of defense systems and equipment. These involve a cross-section of DOD acquisition efforts which are achieving the intent of the legislation—increased pooling of alliance resources to avoid unnecessary duplication of development efforts.

The U.S. investment in these 27 programs over the next 5 years is about $3 billion as currently programmed. Moreover, the allies will collectively invest almost double that amount.

To put it in another way, the United States is reaping the benefit of over $9 billion worth of defense development activity at a cost of only little more than $3 billion.

Last year, Mr. Dennis Kloske appeared before this committee and discussed the international cooperative programs. He gave you a list of 12 projects. Since that time, we have added an additional 15 projects to the list for the total of 27 I mentioned a few minutes ago.

I would not want to go into the details of each of those additional 15, but if I could, I would just like to list them because I think their titles are significant in giving you a good idea of the range of areas that we are covering.

Four programs for the Army were added in the last year: the Combat Vehicle Command and Control Technology development which, by the way, was a fallout of the BTI program, so there is a relation in that one; the Laser Standoff Chemical Detector; Electrooptic Countermeasure systems; and some upgrades to the Patriot system.

Two Navy projects are new. One with which we are particularly happy is the remotely piloted vehicle program with Israel, which is the first project to be initiated under the 1987 legislation that extended the Nunn-Roth-Warner legislation to non-NATO nations, so that is a first in that year. The second new Navy project is the surface ship torpedo defense program.

With the Air Force, we have added the F-16/Agile Falcon project to upgrade the United States and allied F-16 aircraft; the advanced avionics architecture program; the Joint Stars Interoperability effort; and the Ducted Rocket Technology program, another new technology that we are excited about.

Defense agencies have been very active, particularly DARPA, in initiating five additional projects over the last 14 months. The post-2000 tactical communications system, which happens to be with the communications effort, not DARPA, a nonacoustic anti-submarine warfare program, battlefield information collection and exploitation system, C3 procedural interoperability effort and the armor/anti-armor initiative developing capabilities which emphasize the concept of defense versus offensive deterrent.

All of these programs are contributing to our on-going conventional defense improvement effort. We continue to explore new opportunities for cooperation. The 1989 program has a candidate list of 27 programs that are possible additions.

One of the things that faces us in administering this program, and it certainly has been evident in the last 3 to 6 months when you read the paper, is the fact that so many issues confronting defense planners now definitely will affect armaments cooperation.

The changes in arms control, the dramatic developments just within the last 2 weeks in arms control, concurrent reductions in East-West tensions combining with the changing global industrial, political and economic landscape, affect the future course of arms cooperation.

You mentioned, Mr. Chairman, the creation of the single European market in 1992. That is certainly an important thing for us to look out for.

Another effort is the Independent European Program Group—the IEPG. They now are speaking out with a louder voice to develop a European armaments market.

The emergence of the Pacific Rim as a major, regional economic bloc with Japan as the predominant force. We have heard a lot about Japan recently.

The growing concerns on both sides of the river and all parts of the Government about our U.S. trade imbalance, the defense industrial base, and the appropriate levels of burdensharing are subjects very much of interest to this committee and to the Department of Defense.

All of these factors have very major implications for defense budgets and plans and play a major role in shaping our armaments cooperation strategy.

These efforts tell us what we should cooperate in, what countries we should work with, and particularly will guide us in selection as we have more projects than we have time and money with which to proceed.

We have heard a lot about the concern of the European defense market and its incumbent results, which may result in new barriers for U.S. industry. We intend to work very closely with our allies to be sure that this EC 1992 project, however it may come out, will not be to the detriment of the U.S. defense industry.

We are working very closely with Commerce, and the U.S. Trade Representative. We, in fact, are an active member of the U.S. Trade Representative's task force on looking at the European defense market problem.

Perhaps one of the biggest concerns we have is the public perception of a decreasing Soviet threat which carries with it the stress for, within NATO and in our country, a diminished support for defense budgets.

Our position is that with diminishing defense budgets, if anything, the armaments cooperation effort must be even stronger and we believe very firmly that we must work even harder in armaments cooperation in today's world for that reason.

I would like to put in a very short plug for the new program that NATO is developing, the Conventional Armaments Planning System—CAPS. I am sure you have heard something about it and you will hear much more about it, but we are excited about this program. It is encompassing all of the NATO countries.

We are working very closely with our NATO allies and we hope for the first time that NATO will in fact have a system by which they can take the commander's requirements, the military requirements put into that system the necessary input from national resources and national capabilities and come up with some concrete guidance for the NATO commanders and the national commanders as to what they should do in an armaments cooperation way. We look to the CAPS program as input for our armaments cooperation projects.

One program I would like to particularly thank the committee on, and it is a success story for which we thank you for giving us the necessary legislation, is our cooperative procurement of ammunition.

I recognize this committee is really talking about research and development today, but this program I think is important enough to mention because it demonstrates very clearly the importance of cooperating with our allies in the production and procurement fields as well as R&D.

You may recall, Mr. Chairman, that we initiated a program under what used to be called, and maybe still is called, the Quayle amendment that was passed several years ago.

We asked our NATO allies to put in a pot their requirements for 155mm munitions as a pilot case. We took that combined pot of requirements and we had NAMSA, which is the NATO Maintenance and Supply Agency in Luxembourg, put out the request for bids to both United States and European industry. NAMSA then evaluated the bids—we got back about 24 bids, I think—eight of which were accepted.

The end result was that not only did the United States get better prices for this particular item from a U.S. contractor who happened to win the bid, but the NATO allies also got a sizable reduction in the per-unit price of the 155mm munitions which, as you well know, is the cornerstone munition for NATO artillery.

I believe the figures showed that our reduction in the U.S. Army was 11 percent unit cost and for some of the NATO allies it was as high as 30 percent, since they have such small requirements to buy at any time.

The U.S. industrial base got a boost as well because they not only got the benefits of the U.S. order, they got the benefits of many of the NATO countries' orders which had not come to the U.S. industry before.

So we think that is a program that has demonstrated the value of cooperation and we look forward to working very closely with our NATO allies to expand that to more than the 155mm.

I would like to also mention, as another indication of our interest and dedication to the armaments cooperation program throughout the life cycle, that for the first time in 25 years the United States has nominated a U.S. individual to be the chairman, or the general manager, of NAMSA. It is Lieutenant General (Retired) Russo, who many of you may have known as the former commander of the Defense Logistics Agency.

We did this not just to put an American in charge, but because we believe that, with an individual like General Russo as the head of a NATO agency, he will bring to that agency more American business. With more American business we will have more European business and both of us—the Europeans as well as the Americans—will benefit from that cooperation in the follow-on support, maintenance and supply activity.

We have some problems in administering the NATO Armaments Corporation program, though. You mentioned the funding. I would only give the same answer that my colleague gave with regard to funding. The program that was laid out by the committee called for $200 million a year. That has been our objective and continues to be our objective.

With the pressing demands of the budget reductions that we face in the Department of Defense, the resultant funding that came out of the system was approximately $100 million per year instead of the $200 million.

Notwithstanding the reduced amount, we have enough money to conduct the programs that we do have on the books at the present time. What we do not have, of course, is enough money to do new starts in the 1990 and 1991 period. Because we are not exactly sure what programs we want to start in 1989, we have an on-going review in place right now.

Secretary Atwood intends to have armaments cooperation as one of the subjects that he will address in the summer review process. We will provide input to him that will make sure we pull out of the system the best of the programs, the best of the projects, the ones that have the most chances of success and we will recommend to him a level of funding for the initiative in the out years.

We believe the opportunities for cooperation will continue, particularly with the transaction in defense budgets. We see no change in that.

I have one more comment on the defense industrial base, because I know it is very important to this committee. Last year you told us in section 824 to consider the industrial base impact much more than we had in the past in the research, development and production of defense systems and equipment.

We have done that. Since the act became effective, we have forwarded some 30 odd MOUs to the Commerce Department over the past 7 months or so and we have almost a daily interaction with members of the Commerce Department at all levels—the action officer level, Mr. Austin's level, my level, my boss's level, and Dr. Costello, when he was here, met with his counterparts on this very subject.

We hope in the very near future to have procedures agreed upon by both sides that will comply with section 824 and will also give us the very valuable input the Commerce Department can provide on international cooperation and the impact on the U.S. industrial base.

I would also like to mention one other point of clarification because I know it is confusing sometimes when we talk about MOUs. The MOUs that we negotiate under the authority of the Nunn-Roth-Warner legislation are what we call program MOUs.

They should not be confused with the reciprocal procurement MOUs which flowed out of the legislation of the mid-1970s—we have general procurement MOUs with some 17 countries. Nor should they be confused with the specific co-production MOUs that are negotiated by the Defense Security Assistance Agency that have to do with co-production in an overseas country where no U.S. money is involved.

The Nunn-Roth-Warner MOUs that are the subject of this hearing have both United States and foreign money; those 27 projects are what we are talking about.

I think, sir, that is a broad overview of my statement. I would only close by saying that after 10 years as a civilian in the Office of the Secretary of Defense working international issues 24 hours a day, and after 26 years in the Army, I can assure you that as long as I am involved with the program, armaments cooperation is an extremely important part of the defense program and we will continue to do everything we can to put it in the forefront.

Thank you, sir.

[The prepared statement of Mr. Compton follows:]

PREPARED STATEMENT OF
JAMES M. COMPTON
ASSISTANT DEPUTY UNDER SECRETARY OF DEFENSE
(INDUSTRIAL AND INTERNATIONAL PROGRAMS

GOOD AFTERNOON, MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE.

THANK YOU FOR THIS OPPORTUNITY TO ADDRESS THE COMMITTEE REGARDING THE STATUS OF THE NUNN-ROTH-WARNER INITIATIVE FOR ARMAMENTS COOPERATION AND ITS RELATIONSHIP TO THE BALANCED TECHNOLOGY INITIATIVE.

THIS COMMITTEE'S SUPPORT FOR INTERNATIONAL ARMAMENTS COOPERATION IS LONG STANDING. THE NUNN-ROTH-WARNER AMENDMENT TO THE FY 1986 DEFENSE AUTHORIZATION ACT HAS BEEN EXTREMELY EFFECTIVE IN REDUCING NEEDLESS DUPLICATION OF DEVELOPMENT EFFORTS WITHIN THE NATO ALLIANCE. SINCE ENACTMENT OF THIS MILESTONE LEGISLATION, THE UNITED STATES HAS ENTERED INTO 27 AGREEMENTS FOR INTERNATIONAL COOPERATIVE RESEARCH AND DEVELOPMENT OF DEFENSE SYSTEMS AND EQUIPMENT. THESE INVOLVE A CROSS SECTION OF DOD ACQUISITION EFFORTS WHICH ARE ACHIEVING THE INTENT OF THE LEGISLATION -- INCREASED POOLING OF ALLIANCE RESOURCES TO AVOID UNNECESSARY DUPLICATION OF DEVELOPMENT EFFORTS.

THE U.S. INVESTMENT IN THESE PROGRAMS OVER THE NEXT FIVE YEARS IS OVER THREE BILLION DOLLARS. MOREOVER, THE ALLIES ARE COLLECTIVELY INVESTING OVER TWICE THAT AMOUNT. TO PUT IT ANOTHER WAY, THE U.S. IS REAPING THE BENEFIT OF 10 BILLION DOLLARS WORTH OF DEFENSE DEVELOPMENT ACTIVITY AT A COST OF ONLY THREE BILLION DOLLARS.

I WOULD LIKE TO PROVIDE THE COMMITTEE WITH AN UPDATE ON THE PROGRAMS BEING ACCOMPLISHED UNDER THE NUNN-ROTH-WARNER INITIATIVE SINCE THE COMMITTEE LAST HELD HEARINGS ON THE SUBJECT IN APRIL 1988. AT THAT TIME IT WAS REPORTED THAT 12 PROJECTS WERE UNDERWAY. SINCE THAT TIME, AN ADDITIONAL FIFTEEN PROJECTS HAVE BEGUN -- ALL CONTRIBUTING DECISIVELY AND COST-EFFECTIVELY TO IMPROVING ALLIANCE CONVENTIONAL DEFENSES.

THESE INCLUDE FOUR ARMY PROJECTS:

THE COMBAT VEHICLE COMMAND AND CONTROL TECHNOLOGY DEVELOPMENT TO PROVIDE EMBEDDED COMMAND AND CONTROL, AND COCKPIT AUTOMATION FOR GROUND COMBAT VEHICLES SUCH AS THE M1A1 AND THE LEOPARD-2 TANKS;

THE LASER STANDOFF CHEMICAL DETECTOR, A SMALL, LIGHTWEIGHT CHEMICAL CONTAMINATION SENSOR FOR NBC RECONNAISSANCE VEHICLES, ABLE TO QUICKLY MAP TERRAIN, AND TO DETERMINE THE TYPE, LOCATION AND CONCENTRATION OF ANY CONTAMINANTS;

ELECTRO OPTIC COUNTERMEASURES, EXPLOITING RECENT BREAKTHROUGHS IN ALLIED LASER BASED, ELECTRO OPTIC/INFRARED TECHNOLOGY TO INCREASE THE CAPABILITIES OF U.S. SYSTEMS; AND

THE ADVANCED TACTICAL PATRIOT SYSTEM, AN UPGRADE TO THE U.S. PATRIOT AIR DEFENSE SYSTEM ALLOWING IT TO RESPOND TO THREATS FROM ANTI TACTICAL BALLISTIC MISSILES;

TWO NEW NAVY PROJECTS HAVE BEEN INITIATED:

THE REMOTELY PILOTED VEHICLE/MULTI-MISSION OPTRONIC STABILIZED PAYLOAD (RPV/MOSP) WITH ISRAEL, THE FIRST PROJECT TO BE INITIATED UNDER THE FY 1987 EXTENSION OF THE NUNN-ROTH-WARNER LEGISLATION TO INCLUDE PROJECTS WITH CERTAIN NON-NATO NATIONS;

AND THE SURFACE SHIP TORPEDO DEFENSE (SSTD) PROGRAM, DEVELOPING SENSORS AND COUNTERMEASURES TO DETECT, TRACK AND DIVERT INCOMING TORPEDOES. THIS PROJECT PROMISES TO COST EFFECTIVELY REDUCE THE TORPEDO THREAT TO ALLIANCE SURFACE SHIPS.

THE AIR FORCE HAS INITIATED FOUR NEW PROJECTS:

THE AGILE FALCON PROJECT TO UPGRADE U.S. AND ALLIED F-16 TACTICAL AIRCRAFT, BUILDING ON THE EXISTING EUROPEAN F-16 PRODUCTION CAPABILITY;

THE ADVANCED AVIONICS ARCHITECTURE PROGRAM TO SIGNIFICANTLY IMPROVE AVIONICS CAPABILITIES IN EXISTING AND FUTURE ALLIANCE FIGHTER AIRCRAFT, TAKING ADVANTAGE OF TECHNOLOGICAL BREAKTHROUGHS IN DEVELOPMENT OF THE AVIONICS ARCHITECTURE FOR THE ADVANCED TACTICAL FIGHTER (ATF) AIRCRAFT;

THE JOINT STARS INTEROPERABILITY EFFORT, LINKING U.S. TARGET ACQUISITION RADAR PLATFORMS WITH ALLIED GROUND STATIONS. THIS PROJECT WILL SIGNIFICANTLY ENHANCE THE EFFECTIVENESS OF NATIONAL TARGET ACQUISITION SYSTEMS WITH MINIMAL RESOURCE EXPENDITURE, AND

THE DUCTED ROCKET TECHNOLOGY PROGRAM, EXPLOITING BREAKTHROUGHS IN ALLIED VARIABLE FLOW AND DUCTED RAMBURNER TECHNOLOGY, AND

PROMISING A NEW GENERATION OF HIGHLY EFFECTIVE, TACTICAL MISSILE PROPULSION SYSTEMS.

THE DEFENSE AGENCIES ALSO HAVE BEEN VERY ACTIVE, INITIATING FIVE PROJECTS OVER THE LAST 14 MONTHS.:

THE POST 2000 TACTICAL COMMUNICATIONS SYSTEM, A SINGLE, NATO-WIDE SWITCHED COMMUNICATIONS SYSTEM TO REPLACE THE PRESENT GENERATION OF DIVERSE, NON-INTEROPERABLE COMMUNICATIONS EQUIPMENT USED THROUGHOUT THE ALLIANCE;

THE NON-ACOUSTIC ANTI-SUBMARINE WARFARE PROGRAM, TO BETTER ACQUIRE AND TRACK EXISTING AND FUTURE GENERATIONS OF QUIETER SUBMARINES,

THE BATTLEFIELD INFORMATION COLLECTION AND EXPLOITATION SYSTEM (BICES) TO EFFECTIVELY USE NATIONAL BATTLEFIELD TECHNICAL INTELLIGENCE NATO WIDE;

THE C3 PROCEDURAL INTEROPERABILITY EFFORT TO COST EFFECTIVELY EMPLOY EXISTING NATIONAL COMMAND AND CONTROL SYSTEMS TO PASS TACTICAL OPERATIONS REQUESTS AND REPORTS ON A NEAR REAL TIME BASIS, REGARDLESS OF THE NATION OF ORIGIN, AND

THE ARMOR/ANTI-ARMOR TECHNOLOGY INITIATIVE DEVELOPING CAPABILITIES WHICH EMPHASIZES THE CONCEPT OF DEFENSIVE (VS OFFENSIVE) DETERRENT.

THESE PROJECTS ARE CONTRIBUTING TO THE ONGOING CONVENTIONAL DEFENSE IMPROVEMENT EFFORT. MOREOVER, WE CONTINUE TO EXPLORE NEW OPPORTUNITIES FOR COOPERATION. THERE ARE OTHER ONGOING INITIATIVES THAT DIRECTLY RELATE TO THE NUNN-ROTH-WARNER INITIATIVE. ONE OF THESE WHICH BUILDS UPON OUR EFFORTS IN THIS AREA, IS THE DEVELOPMENT OF A MASTER PLAN FOR ARMAMENTS COOPERATION;. THIS EFFORT WILL RESULT IN AN IMPROVED DOD ARMAMENTS COOPERATION STRATEGY WITH SPECIFIC POLICY OPTIONS TO BEST FOCUS COOPERATIVE EFFORTS. AS PART OF THIS EFFORT, DOD WILL DEVELOP OPTIONS FOR BETTER LEVERAGING U.S. CAPABILITIES AS WELL AS THOSE AVAILABLE WORLD-WIDE IN ORDER TO DEVELOP AND EXPLOIT NEW TECHNOLOGIES. THIS WILL BE A VALUABLE MANAGEMENT TOOL TO ENSURE THAT THE U.S. CONTINUES TO MAINTAIN ADEQUATE LEVELS OF DEFENSE WITH OUR ALLIANCE PARTNERS, AND THAT IN MILITARILY CRITICAL AND DUAL USE TECHNOLOGIES, THE UNITED STATES REMAINS HIGHLY COMPETITIVE.

ONE MAJOR ISSUE CONFRONTING DEFENSE PLANNERS WILL BE HOW THE DRAMATIC DEVELOPMENTS IN ARMS CONTROL AND CONCURRENT REDUCTIONS IN EAST-WEST TENSIONS, IN COMBINATION WITH A CHANGING GLOBAL INDUSTRIAL POLITICAL AND ECONOMIC LANDSCAPE WILL AFFECT THE FUTURE COURSE OF ARMAMENTS COOPERATION. SUCH FACTORS AS; THE CREATION OF THE SINGLE EUROPEAN MARKET IN 1992 AND PARALLEL EFFORTS BY THE INDEPENDENT EUROPEAN PROGRAM GROUP TO DEVELOP A EUROPEAN ARMAMENTS MARKET; THE EMERGENCE OF THE PACIFIC RIM AS A MAJOR REGIONAL ECONOMIC BLOC WITH JAPAN AS THE PREDOMINANT FORCE; THE GROWING CONCERNS IN THE U.S. ABOUT OUR TRADE IMBALANCE AND THE DEFENSE INDUSTRIAL BASE; AND THE APPROPRIATE LEVELS OF BURDENSHARING IN NATO AND OTHER PARTS OF THE WORLD, WILL HAVE PARTICULAR IMPLICATIONS FOR DEFENSE BUDGETS AND PLANS AND PLAY A MAJOR ROLE IN SHAPING OUR ARMAMENTS COOPERATION STRATEGY, WITHIN THE DOD MASTER PLAN .

MARKET FORCES ARE CHANGING THE TRADITIONAL WAYS OF DOING BUSINESS, AND FIRMS ENGAGED IN DEFENSE FACE A RAPIDLY CHANGING ENVIRONMENT PARTICULARLY AS THE EUROPEAN COMMUNITY SINGLE MARKET BECOMES A REALITY.

WE HEAR THE CONCERN THAT FORMATION OF A EUROPEAN DEFENSE MARKET MAY RESULT IN NEW BARRIERS FOR U.S. INDUSTRY. WILL THE EUROPEANS TRY TO DO INCREASINGLY MORE TOGETHER WITHOUT OPPORTUNITIES TO PARTICIPATE BEING AFFORDED TO THEIR U.S. AND CANADIAN ALLIES? WILL THAT INHIBIT NATO ARMAMENTS COOPERATION? THE UNITED STATES WELCOMES THE EFFORTS UNDERWAY WITHIN THE EUROPEAN COMMUNITY AND THE IEPG TO DEVELOP A MORE EFFICIENT AND COMPETITIVE MARKET PLACE. WE WILL CONTINUE TO WORK CLOSELY WITH OUR ALLIES TO ENSURE THAT AS THIS PROCESS UNFOLDS, IT WILL PROVIDE FAIR AND OPEN ACCESS TO US DEFENSE INDUSTRY. THE CHALLENGE FOR THOSE OF US RESPONSIBLE FOR OUR DEFENSE MAY BE THAT THE PUBLIC PERCEPTION OF A DECREASING SOVIET THREAT MAY BE A CAUSE OF SOME STRESS WITHIN NATO AND OF DIMINISHED SUPPORT FOR DEFENSE BUDGETS. I BELIEVE THAT DEFENSE BUDGETS WILL BE INCREASINGLY PRESSURED, AND THAT ARMAMENTS COOPERATION WILL BECOME EVEN MORE IMPERATIVE IN DEVELOPING IMPORTANT NEW PROGRAMS IN ADVANCED RESEARCH, DEVELOPMENT AND PRODUCTION IN THE YEARS AHEAD.

ONE ACTIVITY THAT HOLDS CONSIDERABLE PROMISE FOR IMPROVEMENT IN OUR ARMAMENTS COOPERATION PERFORMANCE IS THE NATO CONVENTIONAL ARMAMENTS PLANNING SYSTEM (CAPS). CURRENTLY UNDERGOING A TWO

YEAR TRIAL, CAPS IN INTENDED TO RELATE ARMAMENTS ACQUISITION EFFORTS MORE CLOSELY TO THE REQUIREMENTS AND PRIORITIES OF THE MAJOR NATO COMMANDERS. IT IS EXPECTED TO PROVIDE A MUCH IMPROVED FRAMEWORK FOR IDENTIFYING COOPERATIVE OPPORTUNITIES. THE CAPS TRIAL WILL BE COMPLETED THIS YEAR, WITH THE NATO-WIDE ACCEPTANCE OF A CONVENTIONAL ARMAMENTS PLAN THAT IS NOW BEING DRAFTED WITHIN THE NATO CONFERENCE OF NATIONAL ARMAMENTS DIRECTORS. THE PLAN IS NOT DIRECTIVE IN NATURE -- IT OUTLINES SPECIFIC STRATEGIES AIMED AT REDUCING WASTEFUL DUPLICATION OF EFFORT WITHIN THE ALLIANCE. ULTIMATELY, IT IS UP TO THE NATIONS TO ACT ON ITS RECOMMENDATIONS AND ACHIEVE THE PROJECT-BY-PROJECT COOPERATION THAT WILL RESULT IN COST SAVINGS, INTEROPERABILITY IMPROVEMENTS, AND MODERNIZATION OF FORCES SO BADLY NEEDED IN THE ALLIANCE. ONCE OPERATIONAL, CAPS WILL BE REASONABLY COMPREHENSIVE AND WILL ADDRESS ALL TYPES OF CONVENTIONAL WEAPON SYSTEMS. THE U.S. HAS STRONGLY SUPPORTED THE CAPS CONCEPT, AND IT IS EXPECTED TO ACHIEVE CONCRETE RESULTS. HOWEVER, CONGRESSIONAL SUPPORT FOR THE COOPERATIVE PROJECTS THAT CAPS HELPS IDENTIFY WILL BE A CRITICAL FACTOR IN ITS SUCCESS.

THE DOD ARMAMENTS COOPERATION MASTER PLAN, COMBINED WITH NATO'S CAPS, DOD'S CRITICAL TECHNOLOGIES PLAN, AND THE SERVICES' COOPERATIVE OPPORTUNITIES DOCUMENTS WILL GUIDE THE PRIORITIZATION OF PROJECTS FOR COOPERATIVE RESEARCH, DEVELOPMENT, PRODUCTION AND LOGISTICS EFFORTS WITH U.S. ALLIES.

WE ARE ALSO PURSUING OTHER AVENUES OF NATO COOPERATION. ONE SUCH PROGRAM IS THE CONSOLIDATED PROCUREMENT OF MUNITIONS FOR NATO. THE NATO MAINTENANCE AND SUPPLY AGENCY (NAMSA) HAS SUCCESSFULLY COMPLETED A PILOT EFFORT TO PROCURE VARIOUS TYPES OF 155MM MUNITIONS ON BEHALF OF VARIOUS GROUPINGS OF NATO NATIONS. THIS PROGRAM DEMONSTRATED THAT THE CONCEPT OF CONSOLIDATED PROCUREMENT HAS MERIT. THE LARGE QUANTITY BUYS AND WIDE COMPETITION PRODUCED LOWER PRICES FOR ALL NATIONS. UNIT COST WAS REDUCED BY 11% FOR THE UNITED STATES AND UP TO 30% FOR OTHER NATO NATIONS. MOREOVER, SINCE THE U.S. CONTINUED TO KEEP ITS OWN PRODUCTION LINES OPERATING AT MINIMUM SUSTAINING RATES, THE U.S. INDUSTRY IS HIGHLY COMPETITIVE WHEN BIDDING AGAINST FIRMS OF OTHER NATIONS. U.S. CONTRACTORS WON TWO OF THE EIGHT CONTRACTS AWARDED BY NAMSA, WHILE THE U.S. WAS A BUYER ON ONLY ONE OF THE CONTRACTS. NOT ONLY DID THE U.S. GET MUNITIONS FOR LESS MONEY THAT THEY COULD HAVE OBTAINED UNILATERALLY, BUT THE U.S. INDUSTRIAL BASE GOT A

BOOST AS WELL. NAMSA IS NOW EXAMINING EXPANDING THIS INITIATIVE TO OTHER TYPE OF MUNITIONS.

LET ME BRIEFLY ADDRESS THE RELATIONSHIP BETWEEN THE BALANCED TECHNOLOGY AND THE NUNN-ROTH-WARNER INITIATIVE. THESE ARE COMPLEMENTARY IN THAT TECHNOLOGY AREAS IDENTIFIED IN THE BTI PROGRAM ARE CONSIDERED FOR FURTHER DEVELOPMENT THROUGH ARMAMENTS COOPERATION. FROM THE BEGINNING INITIATIVE, THE DOD OFFICIALS RESPONSIBLE FOR EACH PROGRAM HAVE CLOSELY COOPERATED IN THE PROJECT SELECTION PROCESSES. WITH THIS CLOSE, WORKING RELATIONSHIP, WE HAVE SEVERAL EXAMPLES WHERE A PROGRAM HAD ITS ORIGIN IN ONE INITIATIVE AND WAS MATURED IN THE OTHER. THE ARMY'S COMBAT VEHICLE COMMAND AND CONTROL PROJECT HAD ITS ORIGINS IN THE BTI PROGRAM. DARPA'S ADVANCED SHORT TAKEOFF/VERTICAL LANDING PROJECT WAS INITIATED WITH NUNN-ROTH-WARNER FUNDING, LATER EXTENDED TO THE BTI PROGRAM, AND NOW IS SUPPORTED BY DARPA FUNDING. OTHER PROJECTS THAT ARE CANDIDATES FOR FUTURE FUNDING UNDER THE NUNN-ROTH-WARNER INITIATIVE ORIGINATED AS EFFORTS UNDER THE BALANCED TECHNOLOGY INITIATIVE. ONE SUCH PROJECT IS THE ARMY'S ELECTROTHERMAL GUN TECHNOLOGY. THE ARMY IS DISCUSSING WITH GERMANY THE PROSPECTS FOR A NEW GENERATION ARTILLERY ARMAMENT SYSTEM USING THE BTI RESULTS AS A BASIS.

COOPERATIVE RESEARCH, DEVELOPMENT, PRODUCTION AND LOGISTICS EFFORTS ARE OCCURRING WITHIN NATO AT TRULY UNPRECEDENTED INTENSITY, MAKING THE NUNN-ROTH-WARNER INITIATIVE MORE SUCCESSFUL THAN ANYONE WOULD HAVE IMAGINED JUST THREE YEARS AGO, WITH TWENTY SIX PROJECTS NOW ACTIVE. SUCCESS IS NOT WITHOUT ITS PROBLEMS, HOWEVER, AND WE ARE CURRENTLY CONDUCTING AN IN-HOUSE REVIEW OF THE PROGRAM. THE REVIEW IS EXAMINING VARIOUS ASPECTS OF OSD AND SERVICE EXECUTION OF THE INITIATIVE, INCLUDING THE FOLLOWING:

- THE RELATIONSHIP OF THE PROJECT SELECTION PROCESS TO THE PPBS AND ACQUISITION APPROVAL PROCESSES;

- THE RECOMMENDED LEVEL OF FUNDING FOR THE INITIATIVE;

- THE CONSIDERATION OF OPPORTUNITIES FOR COOPERATION DURING DEFENSE ACQUISITION BOARD REVIEWS; AND FINALLY,

- ANY CHANGES NECESSARY TO ENSURE THE CONTINUED SUCCESS OF THE EFFORT.

THE REVIEW IS BEING CONDUCTED UNDER THE AUSPICES OF THE DEFENSE RESOURCES BOARD, AND IS SCHEDULED FOR COMPLETION IN JULY, WHEN ISSUES AND ALTERNATIVES WILL BE PRESENTED TO THE DEPUTY SECRETARY OF DEFENSE. THE FINDINGS WILL BE FACTORED INTO THE DOD MASTER PLAN FOR ARMAMENTS COOPERATION.

AS PART OF THE FY89 AUTHORIZATION ACT (SECTION 824), THIS COMMITTEE PRODUCED LEGISLATION REQUIRING THE DEPARTMENT OF DEFENSE TO CONSIDER THE INDUSTRIAL BASE IMPACT OF ALL FUTURE INTERNATIONAL AGREEMENTS FOR RESEARCH, DEVELOPMENT AND PRODUCTION OF DEFENSE SYSTEMS AND EQUIPMENT. THERE WAS A FURTHER REQUIREMENT TO SOLICIT INFORMATION AND RECOMMENDATIONS FROM THE DEPARTMENT OF COMMERCE REGARDING THE IMPACT ON THE U.S. DEFENSE INDUSTRIAL BASE. I WOULD LIKE TO PROVIDE YOU WITH A BRIEF STATUS OF OUR EFFORTS HERE. WE HAVE A GOOD WORKING RELATIONSHIP WITH THE DEPARTMENT OF COMMERCE REGARDING THE REVIEW OF THE INDUSTRIAL BASE IMPACT. COMMERCE IS BEING INVOLVED IN THE MOU DECISION PROCESS EARLY-ON -- BEFORE THE U.S. DECISION TO BEGIN NEGOTIATIONS WITH THE ALLIES. MOREOVER, ONCE AN MOU HAS BEEN NEGOTIATED, COMMERCE INFORMATION IS SOUGHT PRIOR TO MOU SIGNATURE. THIS PROCESS IS WORKING WELL, WITH OVER 30 MOUS PROVIDED TO COMMERCE SINCE THE LAW WENT INTO EFFECT ON OCTOBER 1, 1988.

THIS CONSULTATION PROCESS WAS FIRST BROUGHT TO LIGHT DURING THE ADMINISTRATION CONSIDERATION OF THE U.S.-JAPAN AGREEMENT TO BUILD THE FS-X FIGHTER AIRCRAFT. THIS PROJECT HAS RECEIVED MUCH ATTENTION IN RECENT MONTHS, AND THE ADMINISTRATION'S POSITION HAS BEEN ELOQUENTLY STATED TO THIS COMMITTEE AND OTHERS BY A NUMBER OF WITNESSES. HOWEVER; IT SHOULD BE NOTED BY THIS COMMITTEE THAT THE FS-X PROGRAM AND OTHER SUCH EFFORTS EXECUTED UNDER THE U.S. SECURITY ASSISTANCE PROGRAM ARE VERY DIFFERENT FROM PROJECTS INITIATED UNDER THE NUNN-ROTH-WARNER AUTHORITY.

NUNN-ROTH-WARNER PROJECTS ARE LIMITED TO THOSE IN WHICH THE RESULTANT SYSTEM OR EQUIPMENT WILL BE ACQUIRED FOR USE BY THE U.S. MILITARY. CONSEQUENTLY, THESE PROJECTS ARE OVERSEEN BY THE DEFENSE ACQUISITION BOARD AND ADHERE TO THE PROCEDURES OF THE U.S. DEFENSE ACQUISITION SYSTEM AS OUTLINED IN DOD DIRECTIVE 5000.1 AND DOD INSTRUCTION 5000.2.

NO PROJECT IS CONSIDERED FOR FUNDING UNDER THE NUNN-ROTH-WARNER AUTHORITY WITHOUT A CLEAR AND COMPELLING NEED FOR THE SYSTEM BY

U.S. FORCES. FINALLY, THE U.S. SHARE OF FUNDING FOR THE PROJECT IS SPENT IN THE UNITED STATES. THIS REQUIREMENT KEEPS THE FUNDS AT HOME ENSURING THE VITALITY OF THE U.S. DEFENSE INDUSTRIAL BASE WHILE THERE ARE NO SUCH RESTRICTIONS ON THE FUNDS OF OTHER NATIONS, ALLIED GOVERNMENTS, WITH RARE EXCEPTION, CHOSE TO SPEND THEIR FUNDS ON THEIR OWN DEFENSE INDUSTRIES.

THERE HAS BEEN A STEADY INCREASE IN TRANSATLANTIC AND TRANSPACIFIC INDUSTRIAL COLLABORATION THAT IN ITSELF SETS A TREND. THE INTERNATIONALIZATION OF CIVILIAN COMMERCE AND INDUSTRY HAS NOW INEVITABLY REACHED THE DEFENSE INDUSTRIES. THERE IS NO LONGER ANY SUCH THING AS AN INDEPENDENT, STAND-ALONE NATIONAL DEFENSE INDUSTRIAL BASE. WE ARE TRULY INTERDEPENDENT. OUR STRATEGY OF COALITION DEFENSE CAN AND MUST BE BACKED UP BY COALITION RESEARCH, DEVELOPMENT, PRODUCTION, AND FOLLOW-ON SUPPORT.

HOW WE MANAGE THE UPCOMING CHANGES IN THE WORLD LANDSCAPE THAT AFFECT DOD WILL DEPEND UPON WHAT OUR INDUSTRIES CAN OFFER IN THE WAY OF TECHNOLOGY AND PRODUCTIVITY, WHAT NATIONAL RESOURCES WE DECIDE TO DEVOTE TO THE PROBLEM, AND HOW WELL WE CAN SHARE AND WORK TOGETHER.

REGARDLESS OF MR. GORBACHEV'S SUCCESS IN RESTRUCTURING THE SOVIET SYSTEM, AND REGARDLESS OF THE MOST OPTIMISTIC PROGRESS IN ARMS CONTROL, THE SOVIETS WILL REMAIN A MILITARY SUPERPOWER REQUIRING A CONTINUING MILITARY BALANCE. OUR CHALLENGE WILL BE TO PROVIDE A QUALITY FORCE STRUCTURE, IN AN ENVIRONMENT OF SEVERELY CONSTRAINED RESOURCES.

WORKING TOGETHER -- GOVERNMENT-TO-GOVERNMENT, GOVERNMENT-TO-INDUSTRY, AND INDUSTRY-TO-INDUSTRY -- WE CAN PROVIDE THE COMMON DEFENSE WE NEED WITHIN THE RESOURCES OUR SOCIETIES CAN AFFORD.

THIS CONCLUDES MY PREPARED STATEMENT. I WILL BE GLAD TO ADDRESS ANY QUESTIONS THAT YOU MAY HAVE.

Chairman NUNN. Thank you very much, Mr. Compton. We are going to keep the usual time here and I will ask to be notified when our time has expired.

RESEARCH AND DEVELOPMENT

Mr. Compton, the ultimate purpose of this program was to begin at the research and development stage so that we could eventually have more joint procurement and more commonality, interoperability, on the battlefield.

I know that most of your programs are in research and development now and not in production. At what stage will production decisions start being made on these programs and how do you view that as coming in terms of discussions?

Mr. COMPTON. Well, of course that would be based on each situation—each individual project would have a different time.

Chairman NUNN. Right.

Mr. COMPTON. There are some that are already in 6.3 level funding, advance development. Those will be coming up faster than others.

155-MM

One that particularly comes to mind, I think, is the 155 millimeter autonomous projectile. That could well come very soon. How soon is soon? The figures I have seen indicate maybe several years before we would be ready to field it.

Some are probably much further off in the future. We will not gain anything from this program, obviously, if we are entering into programs in the development phase that show no likelihood of ever coming to cooperative procurement. If you simply have something developed, it never gets into the field. It does not end up in any increased readiness.

Chairman NUNN. I guess it depends on who "we" is. NATO—for NATO that is for sure, but for the United States, if we would have otherwise undertaken the project and spent 100 percent of the money instead of undertaking it and spending one-third of the money, we have saved two-thirds of the money that would have been spent on it.

Mr. COMPTON. Yes, sir, we have. But even for our programs, if we do not carry it through production on a national basis, then we put it on the shelf and it has not resulted in any improved capability for the Department of Defense.

Chairman NUNN. What I am trying to get to, the point is, do you believe that this program and what you see of it now has the promise of really, down the road, maybe 5 years, 10 years, really leading to a number of cooperative programs and therefore to more commonality and interoperability on the field of battle?

Mr. COMPTON. I have no doubt at all. Absolutely. Because if it does not, we have picked the wrong projects and we better go back and look very closely for the ones that will lead to cooperative programs because that is certainly the end product for which we should work.

Chairman NUNN. Well, do you believe that is going to happen?

Mr. COMPTON. Yes, sir. Absolutely.

Chairman NUNN. Do you think the other countries have a similar goal?

Mr. COMPTON. I think so. Now, I would be less than honest if I said that all 27 of the projects currently on the books are going to lead to that.

Chairman NUNN. Well, of course, the very nature of research and development is you rule out certain areas and you are going to have a lot of them that never do go to production. That is true in any research program.

Mr. COMPTON. Yes, sir. But I definitely believe that we will get to that point, sir.

Chairman NUNN. Last year, Dennis Kloske explained that in his own view there were several things that needed to be done in this cooperative R&D program. First he explained that we needed to work out lighter and more flexible industrial management procedures for the projects.

Second, we must provide a stable financial environment for the projects. Third, the Defense Department needs to work harder on developing a flexible and reasonable technology transfer framework and fourth, he said we needed to be more selective in choosing more ambitious programs that meet NATO's priority requirements.

First, do you agree with those general statements? Second, could you tell us what has been done in the last year on each of them, starting with let us say the first one, which is more flexible industrial management procedures?

Mr. COMPTON. I certainly still agree. I agree with all four of those. I spoke with Mr. Kloske last week, as a matter of fact, not on all of these subjects, but I can tell you they are still the objectives of the Department. We are trying very much in the review I mentioned just a few minutes ago to look at this process, because the process has become bigger than the product in some people's view.

We have gotten to the point now of having 27 separate projects with as many others standing in the queue. We obviously cannot handle it with our current administrative setup, so one of the key objectives of our review that is on-going will be to better integrate the management of these programs into the current PPBS process with which the Department is very familiar, where we have people dedicated to doing these kinds of things.

Up to this point, we have sort of hand massaged it, because it was a new program. It was an unusual program and we felt it needed the personal attention of OSD level, if you will, leadership.

I think it now has been accepted by the services—I know it has been accepted by the services and I think it is now time for us to simplify it by putting it into the regular established R&D funding process with which the services are familiar, and I think that is flexible.

By saying that, I do not mean that we are going to give up on monitoring it very closely, because we will always have that monitorship at OSD, but we cannot handle the individual details on every single project.

We certainly cannot negotiate all the MOUs. That is beyond the capability of OSD and, as we get into the MOU negotiation, and as we get into implementation, working with the allies just consumes an awful lot of manpower and time.

Chairman **NUNN**. So who is going to do it?

Mr. **COMPTON**. The services will be charged with the specific responsibility of negotiating, implementing and moving along with the program. We will continue to exercise control through our International Programs Committee—one of the committees of the Defense Acquisition Board [DAB]—the funding allocations, setting the priorities, choosing the projects and providing the overall management review. I think that is the flexible approach.

Chairman **NUNN**. The second thing he requested, or at least suggested, was a more stable financial environment. Of course, you have already addressed the budget funding. Next, he said we need to work hard on developing a flexible and reasonable technology transfer framework.

Mr. **COMPTON**. Yes, sir. I am less comfortable with giving you an answer off the top of my head on that, because the problems we run into there are some that I believe will be addressed by the Defense Management Review that is on-going, which perhaps is going to be announced fairly soon.

The overall problem is not unique to the Nunn-Roth-Warner R&D program. The problem goes far beyond that, because we have the difficulties of working with our allies, working within the COCOM arrangement, working with the ever-changing rules on technology transfer, internal to the Government as well as through all of the governments, and I will have to admit to you, that we do not have a full handle on the technology transfer issue yet, as much as I feel we have on the other three points that you mentioned.

Chairman **NUNN**. What about selecting more ambitious programs?

Mr. **COMPTON**. Absolutely, and our 1989 selection will indicate that the programs we are selecting now will have more relevance, and will cut out some of the ones that are somewhat marginal in their value. We need fewer programs that are bigger, instead of having a lot of small programs, which consume too much administration.

Chairman **NUNN**. My time has expired. Thank you, Mr. Compton. I will come back with questions for Dr. Duncan. Senator Thurmond.

Senator **THURMOND**. Thank you, Mr. Chairman. We are very pleased to have you gentlemen here.

BTI FUNDING

Dr. Duncan, the Balanced Technology Initiative funding request for fiscal years 1990 and 1991 is less than $200 million each year. How much was the BTI funding request before the budget adjustment, and were some of the research projects impacted by the budget reductions?

Dr. **DUNCAN**. Senator Thurmond, you said less than $200 million. I think it is just slightly over $200 million per year. $206 million for 1990 and $201 million for 1991.

Senator **THURMOND**. I said less than $210 million each year.

Dr. **Duncan**. Oh, I am sorry. I misunderstood you. The numbers that I have for the totals of these programs are for those 2 years $379 million for fiscal year 1990 and $293 million for fiscal year 1991.

Senator **Thurmond**. Dr. Duncan, in your prepared statement you indicate that one of the additional benefits of the BTI program is that the available BTI resources facilitate the timely initiation of research work in new areas.

I interpret that statement as meaning that if the Defense Department receives an innovative proposal in support of the BTI program, the services can use BTI resources to fund the evaluation of the concept without obtaining prior budgetary approval. Is my assumption correct, and how does the Department determine which innovative ideas get funded and could you give me some examples of programs that have received this type of consideration.

Dr. **Duncan**. Your assumption is correct, Senator Thurmond. At the beginning of the year we go through a process of determining which projects we are going to support and we allocate all of the resources that are available to us.

However, we find that through the very slow process of getting things under contract, we do have funds available to us when an emergency arises. An example of an opportunity we were able to respond to involved the discovery by scientists in Texas and in other places of high temperature superconductivity. It was possible for us, through the BTI program, to provide the first funds that the Government invested in that particular area.

BTI is not planning to continue funding high temperature superconductivity at this time, but we did get work started with BTI funds that was later picked up with other funds, primarily through DARPA. That is an example of the way we can operate.

ARMOR/ANTI-ARMOR PROGRAM

Senator **Thurmond**. On May 4, Dr. Duncan, the Conventional Forces and Alliance Defense Subcommittee held a hearing on the Department's armor/anti-armor program. During the hearing we were briefed on the Army's and Marine's co-efforts to modernize our capabilities in these areas.

The BTI program lists two programs, short-range antitank weapon and armor materials, that appear to fall into the same area. Are these two BTI programs parallel initiatives to the services armor/anti-armor program, and what mechanism is there to ensure all of these research efforts are coordinated?

Dr. **Duncan**. That is a very good question. The answer is yes, they are coordinated. Regarding the armor/anti-armor program—let me go back a little bit.

In 1985 the Defense Science Board pointed out that there was a serious problem vis-a-vis the red forces in our armor capability and our anti-armor capability. Even with projected upgrades of our systems and of their systems, this imbalance would exist well beyond the year 2000.

A coordinated DARPA, Army and Marine Corps armor/anti-armor program was started. Its basic goal was to try to change that imbalance. Funds in excess of about $50 million, as I recall, were put into that effort.

The activities and the selection of which specific projects to support were overseen by an executive committee made up of general officers from the Army, Marine Corps, and senior officials from DARPA.

When we established the armor/anti-armor initiative in the BTI program we relied on the advice of some of those same people to help us expand the on-going work. I think of all the programs we have this may be the best integrated.

Integration of armor/anti-armor work is perhaps easier because there is a very well-focused mission. In some of our other areas all of the services are involved and the missions involved are much broader.

TACTICAL MISSILE DEFENSE

Senator THURMOND. Dr. Duncan, you indicate in your statement that you will soon sign a memorandum of understanding with the Federal Republic of Germany for doing work on tactical missile defense. What do you hope to achieve with this program and how much will it cost, and what will the Federal Republic contribute to the development effort?

Dr. DUNCAN. I cannot tell you off-hand how much the Federal Republic of Germany——

Senator THURMOND. Do you want to supply that answer for the record?

Dr. DUNCAN. Yes, sir. Let me supply that answer for the record.

Senator THURMOND. All right.

[The information follows:]

TACTICAL MISSILE DEFENSE AGREEMENT

As I noted in my prepared statement for the record, a BTI/Army project involving interceptor guidance, warheads, and command and control for tactical missile defense (TMD) has facilitated development of an agreement with the Federal Republic of Germany for joint work in this general area. An enabling Memorandum of Agreement (MOA) entitled "A Cooperative Program for Extended Air Defense" was signed on April 28, 1989. This MOA covers a twenty-year period and provides a structure to facilitate startup of more specific cooperative programs. Details, when established and agreed to, will be recorded as annexes to the MOA. The first such annex concerns joint demonstration of an active seeker in a PATRIOT missile that will enhance its capabilities. The total cost of this work is $65 million, of which $19.8 million is being contributed by the Federal Republic of Germany.

NATO COOPERATIVE R&D PROGRAM

Senator THURMOND. Mr. Compton, last year this committee was briefed that the United States contributed approximately 30 percent of the funds for the NATO Cooperative Research and Development Program during fiscal years 1986–87. Has this figure changed since that briefing, and do you expect the U.S. share to be reduced in view of the defense budget reductions?

Mr. COMPTON. The answer to your first question, Senator Thurmond, is that our latest figures, as of this morning, the number for the United States is approximately in the 37–38 percent range, with the remainder coming from the allies.

In response to your second question, I would not expect the contribution of the United States to be related to the decrease in the overall defense budget, because the contributions of the United States are more related to the amount of funding that we get from the allies. If we properly select the projects that have the full support and the full funding of the allies, then there is no reason why our percent should go down with the defense budget. We would like to see the U.S. portion go down, but what I am trying to say is that it is not necessarily related to the reduction of the defense budget.

Senator THURMOND. Mr. Chairman, I have got to leave. I have one more question. Do you want me to prepare it and submit it for the record?

Chairman NUNN. I would be glad for you to go ahead, if you would like to.

Senator THURMOND. Thank you Mr. Chairman. Just one more.

Chairman NUNN. Okay.

DEFENSE INVESTMENT DECISIONS

Senator THURMOND. Mr. Compton, there has been a growing tendency in Europe to make defense investment decisions based on the needs to maintain and develop specific technological capabilities that preserve the competitiveness of the national defense industrial base.

These investment decisions many times tend to favor weapons for export rather than the needs of NATO's defense. How has this tendency towards maintaining their own defense industries impacted on our attempts to encourage co-development of weapons without NATO allies?

Mr. COMPTON. Well, it has impacted. There is no question about that, Senator, because we frequently, in our negotiations with the allies, will run across that very problem. Let me say it is not unique to the Europeans, because we have the same concerns.

Every country we deal with that has a mature industrial base, automatically will come in and say they have to negotiate an agreement that will provide some protection for their own industrial base.

So it is very much a limitation, if you will, on the degree to which we can go on cooperative procurement and cooperative development programs.

Senator THURMOND. Thank you very much, Mr. Chairman. I would like to have my statement made part of the record.

Chairman NUNN. Thank you, Senator Thurmond. It will be included.

[The prepared statement of Senator Thurmond follows:]

PREPARED STATEMENT BY SENATOR STROM THURMOND

Thank you, Mr. Chairman. I join you in extending a warm welcome to both Mr. Duncan and Mr. Compton.

Mr. Chairman, I supported the Balanced Technology Initiative when it was initially proposed in the 99th Congress. At that time I though the program presented a unique approach toward ensuring the improvement of our conventional defense capabilities. The research that the services have done as a result of this initiative has already paid dividends and will certainly enhance our forces' capabilities in the near term.

In his prepared statement, Mr. Duncan, indicated that the Balanced Technology Initiative is an important element of the DOD Science and Technology program. I want to echo those comments and urge my colleagues to continue their support for this vital initiative. Although we may be able to reduce our manpower and procurement, we cannot afford to reduce our research and development program, since it represents an investment in our nation's future.

Thank you, Mr. Chairman.

Chairman NUNN. Senator Bingaman.

Senator BINGAMAN. Thank you, Mr. Chairman. Dr. Duncan, as you know, your office provided us with a report earlier this year—in fact, I think it was prepared primarily under the direction of Dr. Millburn as your Deputy Director for Research and Advanced Technology. Is that the right title?

Dr. DUNCAN. Yes, sir. Dr. Snowden is in his office.

Senator BINGAMAN. All right. A report listing what you determined to be the most critical technologies for purposes of weapons systems—I think the statute we passed last year said that you were to identify the technologies most essential to develop in order to ensure the long-term qualitiative superiority of U.S. weapons systems and that is what was done and 22 were identified.

U.S. CRITICAL TECHNOLOGY RELATED TO BTI

I guess my question is, how do we relate those 22 to the Balanced Technology Initiative? There is some obvious overlap? Here in your testimony you say on page 2 that you picked out a few technological areas considered critical to the successful execution of conventional defense missions as what you are trying to accomplish. I just wonder if a better wedding of these two together would not benefit you and your ability to set priorities and us in our understanding of how those priorities are set.

Dr. DUNCAN. We did overlay the Balanced Technology Initiative and the Critical Technologies Plan.

The Balanced Technology Initiative program is run out of Dr. Millburn's office by Dr. Snowden and the 22 critical technologies study was also directed out of the same office, not by Dr. Snowden but by others in that office.

After we had completed that study, we took the Balanced Technology Initiative and all the projects that are involved there, including the 15 that we initiated most recently, and found that BTI work involved projects in 21 of the 22 areas listed in the Critical Technologies Plan.

The only area where we did not have anything going was in the biotechnology area.

Senator BINGAMAN. What area?

Dr. DUNCAN. Biotechnology, which I believe was the last of the 22 technologies. I have a chart which shows what projects are in each of those 22 areas which I can make available for the record.

Senator BINGAMAN. That would be very useful.

[The information follows:]

	BTI Technology Thrust Areas				
Critical Technologies	SWT	RSTA/BMC3	A/A-AT	HPM	STO
1. Microelectronics Circuits and Their Fabrication	x				
2. Preparation of GaAs and Other Compound Semi-Conductiors	x				
3. Software Producibility	x	x			
4. Parallel Computer Architectures	x	x			
5. Machine Intelligence/Robotics	x	x	x		
6. Simulation and Modeling	x	x	x		
7. Integrated Optics		x			
8. Fiber Optics		x			
9. Sensitive Radars	x	x			x
10. Passive Sensors	x	x	x		
11. Automatic Target Recognition	x	x	x		x
12. Phased Arrays		x			
13. Data Fusion	x	x	x		x
14. Signature Control				x	x
15. Computational Fluid Dynamics			x		
16. Air Breathing Propulsion					x
17. High Power Microwaves				x	
18. Pulsed Power			x	x	
19. Hypervelocity Projectiles	x		x		
20. High-Temperature/High-Strength/ Light-Weight Composite Materials			x		
21. Superconductivity					x
22. Biotechnology Materials and Processing					

Dr. **Duncan**. We did indeed make that comparison for the very reasons you outlined.

Senator **Bingaman**. I guess the point that I am driving at is whether it makes sense to think of the Balanced Technology Initiative primarily as a program to fund the insertion of these critical technologies in actual weapons systems—or fund the research and development necessary to insert the critical technologies. Is that a reasonable way to think about what your main thrust is in the Balanced Technology Initiative?

Dr. **Duncan**. Yes, sir. I think you have described that very well.

Senator **Bingaman**. I am wondering if it would not be helpful as we rethink this, to be more explicit and to say that is really what we intend to do with these Balanced Technology Initiative funds. That is to provide DOD with the funding necessary to not only pursue critical technologies but to pursue the additional developmental work necessary to see that those technologies wind up as a usable item or a usable component in a weapons system.

Dr. **Duncan**. I think it is a very good recommendation and we will do that. The Balanced Technology Initiative is a 6.3A program and SDI is also a 6.3A program. Its purpose is to develop and demonstrate advanced technology and to help bridge the gap between the research laboratory and weapons in the field, or the prototype. We will try to articulate that better in our future——

Senator **Bingaman**. Well, let me also try to zero in on another aspect of this.

STRATEGIC DEFENSE INITIATIVE

When the Balanced Technology Initiative was initiated by Senator Nunn and Senator Cohen, I think one of the ideas clearly was that Congress was concerned that more emphasis was going to the Strategic Defense Initiative research activities than was appropriate, and that money was being robbed from some of these other activities which were also very important.

Is it your view that the Balanced Technology Initiative still needs to be on technologies that are not related to SDI? Is that a valid distinction to draw here? That was put in the original legislation. I think that has been part of what people have been trying to do up until now. What are your thoughts about that?

Dr. **Duncan**. It was my interpretation of the law that originated here that we were to concentrate on those things that were not SDI. Non-SDI primarily to enhance the capabilities of our conventional forces and our allies' conventional forces. So we consciously worked at defining projects and programs that would do just that.

Now, there was language in the report about SDI and when I first came into DDR&E, the selection had already been made for the first category of programs. But, the way I read the law the first time around was that maybe we were expected to and should set up, something like SDI as far as how to run the program. And we should sweep into it things that were already going on in other places, much like the directed energy work out of DARPA—$300 million was swept into SDI and so forth—and make that the Balanced Technology Initiative and include into it the additional funds that were provided by this committee and by the appropriations.

That is an awfully big undertaking and the SDI program had a Presidential initiative to it. To be able to sweep up all these programs and put together well-defined activities in each of the areas that were necessary in the conventional defense area seemed more than we could do in the time that was available to us to do it.

Senator **Bingaman**. I have some other questions I will get on the second round. Thank you, Mr. Chairman.

Chairman **Nunn**. Thank you, Senator Bingaman. Senator Cohen.

Senator **Cohen**. Senator Bingaman, if you want to continue anything I have got enough time if you want to follow up on what you just asked.

Senator **Bingaman**. Well, I have two or three others but go ahead.

Senator **Cohen**. Basically what we are afraid of, I might say, in adopting this legislation was that SDI was soaking up all of the money. We were concerned about the disproportionate amount of research and development that was just being drained away from all of the other services and said we have got to do something on the conventional side.

I guess there are a number of questions I have, but you said you had roughly $206 million fiscal year 1990, $201 million fiscal year 1991, to pursue some 50 projects. Is that correct?

That works out to about $4 million per project. Are we picking too many projects? Is that not too little money for that many projects. So you end up, to use your expression, that this program really can make a difference. How do you make a difference with $4 million a project?

Dr. **Duncan**. Well, that is a very valid question, Senator Cohen. But even a big project is broken up into smaller pieces. If you start out and define an airplane to build, you break it up into its avionics and its structures and you break it up into teams of people who do work on various elements of it. In this particular case, what we have done is we have started at the piece level, and hopefully the pieces collectively represent a focused activity which could lead to larger things.

Senator **Cohen**. When you say 50 projects, then, do you mean it could be five projects in 50 pieces?

Dr. **Duncan**. I am not sure I understand the last point you made.

Senator **Cohen**. You said you break up—you could have one project in many separate pieces that would be funded. The question I have when you say that you have 50 projects going, does that mean you have basically—you could have 5 or 10 projects broken up into 5 or 10 pieces?

Dr. **Duncan**. What we have are of the order of 50 projects broken up into four primary pieces—armor/anti-armor, RSTA, battle management and so forth.

Now, each collection of projects in a particular area is not designed to build a specific weapons system which would more than encompass all the money that is available in that area. Rather, they are designed to advance the technology in each of the elements that would represent a weapons system. Some of these will be successful and some will move ahead of others.

The cruise missile advanced guidance project, as an example, has moved far enough along that it is being incorporated into the long-range conventional cruise missile work of the Navy and Air Force.

MILESTONES OF PROGRESS

Senator **COHEN**. You said you read the initial law that was passed with some scrutiny. As I recall, the initial law also contained language that the committee wanted to have certain milestones set for various projects so that we would have some measure, or standard against which you could measure progress.

To my knowledge, no such milestones have ever been submitted to the committee. How do we know—I mean, in other words how do we gauge that progress is being made?

Dr. **DUNCAN**. I have a record of those projects which we consider to be completed, or projects that have transitioned. Of the projects that we started, we have eight that have been completed or transitioned. The cruise missile advanced guidance project that I just mentioned is one of these.

Senator **COHEN**. No, I meant there have been no milestones submitted for the committee to look at so that we could make some determination in terms of how the projects are coming along, how the programs are going.

Dr. **DUNCAN**. We could work at defining milestones, but in an R&D activity it is not as easy to define a milestone as it would be in a platform or a weapons system activity.

The best gauge that I know of is to say, is this project being incorporated into a larger system? Is it becoming a subsystem of a larger system?

AMPHIBIOUS ASSAULT COUNTERMINE SYSTEM

Senator **COHEN**. I will come back to that. The unclassified report submitted back in April indicated that you had several projects and one of them happened to be an amphibious assault countermine system that was transitioned over into the individual services.

Now, were these dropped from the BTI program because they were not sufficiently, I guess promising, to merit BTI funding?

Dr. **DUNCAN**. That particular one was dropped for that reason, yes, as I recall. Is that correct?

Dr. **SNOWDEN**. I am sorry, I was back to the milestones question.

Senator **COHEN**. Okay. All right.

Dr. **DUNCAN**. I think, as a matter of fact, Senator Cohen, that is the only project that I can say that we have dropped specifically for that reason.

Senator **COHEN**. If you drop them because they are not sufficiently promising and you turn them over to a service, does that mean that the service would be warranted in pursuing the technology even though it is not qualified, in your judgment, for BTI funding?

Dr. **DUNCAN**. It is not warranted because it does not meet the objectives of the BTI program.

Senator **COHEN**. But the service might still go forward with the technology itself?

Dr. **DUNCAN**. The goal of that particular program was to help destroy mines, particularly mines that were in the surf, in beach areas, for Marine Corps assault activities. It involved using fuel-air explosives.

DROPPING A PROGRAM FROM BTI

Senator COHEN. What I want to know is, when you drop a program from BTI and you turn it over to a service, does that generally mean that the program itself no longer merits funding under BTI because it does not meet the criteria? Or are you turning it over to the service to say, okay, take it to full-scale development now?

Dr. DUNCAN. The latter. In most of the cases we hope it is the latter and we hope the service picks up the funding and that frees up future BTI funding for new projects.

Senator COHEN. What is your role once you turn it over? What do you do to follow it to fruition once it is turned over?

I hope the other service does not put it on the shelf and say that is all well and good for BTI but we do not need it right now and do not want it. We have a higher priority over here. What do you do?

Dr. DUNCAN. My role as Director Defense Research & Engineering is still to be involved, but not in the context of BTI, because I am responsible for all of the R&D activities.

Senator COHEN. What specifically do you do once you turn it over? How do you maintain oversight once you turn it over to a service?

Dr. DUNCAN. I would say it is difficult to generalize, but one of the elements of oversight, particularly if a program has some controversy around it, involves meetings to review what progress it is making and so forth, and whether there are other things that we should do to make it possible to be more successful.

This oversight activity is part of the normal budget review when the technology is being incorporated into a larger weapons system. Judgments are made as to whether that weapons system should move forward and at what rate it should move forward—what IOC date it should have and that sort of thing.

Senator COHEN. I will come back to it. Thank you, Mr. Chairman.

AVIONICS SYSTEM

Well, I have just one other question. Could you take one particular project and sort of walk us through that project, how you intend to get a fielded system that "leapfrogs" the current deficiencies we have?

I want you to take one example listed in your testimony and that is one of the new projects you list as really promising: avionics for clandestine operations that would enable low-level flight and provide greatly enhanced radar SIGINT avoidance capabilities. Now, tell us exactly how you end up with a fielded capability on that particular program. Page 9, I think.

Dr. DUNCAN. That is one that we are doing for the SOF community.

Senator COHEN. Special Operations. Right.

Dr. DUNCAN. Let me see if I can find the reference to it here.

Senator COHEN. It is on page 9.

Dr. DUNCAN. I am looking at a different document.

Senator COHEN. Oh, I am sorry.

Dr. DUNCAN. Do you have a page number in this one? Oh yes, here it is.

This is a new program. So let me first say that I am not yet familiar with the specific set of milestones for that particular program and how it would be moved into the Special Operations Forces community, but its purpose is to make it possible for avionics systems to operate in a clandestine environment, just as the name describes. I do not know even whether it is under contract yet or not.

Senator COHEN. Well, you see I think every one of us around the table would know that we have got to have an avionics system like this for Special Forces that we have been after in order to get the kind of airlift that is necessary to have a covert penetration of a hostile area. So we know that as a general concept.

Now just tell us, if you could, now we have got a concept, tell us how you take it—this may take too much time and perhaps we ought to come back to it, Mr. Chairman.

Chairman NUNN. I think you are getting right at the heart of what I really have in mind in my next question too, and that is, how do we measure success? How do we know that this program is really producing for the military forces of our country leapfrog technology and putting it in the field, and when are we going to be able to judge that?

Dr. DUNCAN. It is a very important and a very difficult question to answer.

Senator COHEN. Or failure. When do we recognize that we ought to scratch this effort and decide to do it another way? How are we going to judge this program?

Dr. DUNCAN. I would say the measure of success would be whether or not the work leads to broader application, incorporation into a larger system—into a weapons system, into a platform, into a smart weapon, or whether it is incorporated into something that already exists because of the demonstrated laboratory work that we have done in support of the project.

ACE WARGAMING PROJECT

An example—it may not be a typical example is the ACE wargaming project. It is the largest project that we started this year. It was started at the encouragement of General Galvin, and addresses the need for Corps level simulation in the NATO arena. The system has been used already by General Galvin with four corps—with the commanders of four corps participating. We intend to expand it, not using BTI funds but using Army funds, as transition into the Army.

Chairman NUNN. But that started in BTI?

Dr. DUNCAN. That started in BTI, yes sir. That was an $18 million project. It was the largest single BTI project among the new starts. Now that is not a platform project, but it does represent an enhancement of our readiness capability that is very, very significant.

Chairman NUNN. Well, I agree with you on that. I just had a chance to spend some time with General Galvin in Europe and the fact is that whole effort towards more state-of-the-art simulation has allowed us to cut down the size of our exercises there, including reforaging, which has tremendous advantages in terms of cost savings, in terms of damage done within Europe, in terms of public relations in Europe, in terms of perhaps even confidence building with the Soviet Union in terms of exercises, so that has a big effect.

Dr. DUNCAN. Did he show you, by any chance sir, the vans that operate for the corps commander and the——

Chairman NUNN. He told me about it.

Dr. DUNCAN. He told you about it? That is a BTI project. I consider that to be a great success. The BTI has made a great contribution, but that is not a typical project because you cannot measure success generally in 1 year.

Chairman NUNN. Would that have occurred without BTI?

Dr. DUNCAN. I do not know how that project would have occurred without BTI. It would have required some organization, logically the Army, to be supportive of it to the extent of being able to put in substantial amounts of money.

Chairman NUNN. Are you saying that probably would not have happened, or it is a question whether it would have happened?

Dr. DUNCAN. It is a question whether it would have happened.

Chairman NUNN. Senator Cohen, I did not mean to interrupt you but I was thinking along the same line exactly. That is an example. Why do you not go ahead and finish.

Senator COHEN. Well, it is just a question if you could take us through the steps so that we know how you make these decisions, when do you take it out of the embryo stage and it kind of shifts to something else? When does the worm go to a butterfly?

Dr. DUNCAN. You chose about the most difficult example possible for me to do so.

Senator COHEN. I did not choose the example, it is listed here. Well I mean, for me—you picked it for me.

Dr. DUNCAN. That project is hard to discuss for a couple of reasons. One is my own familiarity with the project and the second is the early state of the project.

Senator COHEN. You give me one then, okay? Give me one that you are comfortable with. That is good enough.

Dr. DUNCAN. Another short term example is the super conductivity project I mentioned earlier, how we used BTI to get DOD work started on superconductivity. One similar to that is now a NATO program, the ASTOVL program—the advanced short-range takeoff and vertical landing aircraft program that we are now doing with the United Kingdom. BTI funded that work for 1 year.

Senator COHEN. That is a modification of the AV–8B?

Dr. DUNCAN. No, it is a look at an entirely new aircraft system. It is being done by people who are very familiar with the AV–8B. The project is continuing to be funded by DARPA and is part of the NATO alliance program.

Senator COHEN. I think that what—it is a hard way to express it, but what we are looking for is, how do we know as you are going along whether things are being dumped at this point because they are simply in your judgment now valid, whether they deserve to be moved along?

What sort of guidelines do they have? Have they been institutionalized? What judgments are brought to bear? How do we know, that is all? I am just trying to find out what judgments come to bear at particular points in time where you say, let us continue this. Let us move this over to the Marine Corps. Let us give it to the Navy, let them continue it or dump it as they see fit.

I mean, where do you make the judgments and how has that been formalized, or has it been formalized?

Dr. DUNCAN. We have a committee of people made up of a senior member from each of the services, a member from the Joint Chiefs of Staff, representatives from each of the program offices within DDR&E. By program offices I mean tactical warfare programs, strategic and theater nuclear forces programs, research and advanced technology programs, and DARPA. That particular group, under the leadership of Dr. Snowden, looks at each of these projects and examines the progress that is being made and makes the judgments. You do not transition something into the Army, Navy or Air Force unless they want it, and the program has to show progress.

In a few cases, we have had enough progress already that they have moved into the services; the ACE wargaming being an example.

Senator COHEN. If you were to transition something over—the amphibious assault countermine system, what happened to that? That transitioned over or just dumped? What do you call it?

Dr. DUNCAN. We stopped doing that program.

Dr. SNOWDEN. May I answer that question?

Dr. DUNCAN. Yes.

CATFAE PROGRAM

Dr. SNOWDEN. The BTI program initially supported accelerated development of the CATFAE program because the Marine Corps came to us with a plan whereby with BTI resources we could accelerate the IOC by 3 years, to 1991. Accelerating the CATFAE system, accelerating the capability that it is going to provide us to breach the surf zone, was a strong recommendation in a 1987 Defense Science Board. When it came time for me, as I do at least biannually, sitting down with each project manager, to review progress on that program, it became clear after the first year of activity by the Marine Corps that they were, much to our regret, too willing to quickly give up the 3-year advance in the IOC that we had sought. They moved the IOC back after 1 year of spending BTI resources to 1994. Since BTI has claimed to be trying to make a difference in executing conventional defense missions, and that was not going to make a difference, we stopped our support for the program. We could revisit it with the Marine Corps if they are able to convince us that in fact there is something significant we can contribute, but it was terminated for a very good reason. They were not performing.

Senator COHEN. I do not question that. I just want to know what happened to it, that is all. Do you call that transitioning or terminating?

Dr. SNOWDEN. That is terminating.

Senator COHEN. I think all we are asking is some guidelines from you as to how, at what point in time, those decisions are made, so that when we look over the list of projects you have under examination we can say that it looks like the program is working.

Dr. DUNCAN. Are you suggesting that perhaps we should provide the committee on a continuing basis for each of the projects, a definition of what progress we are making?

Senator COHEN. Yes, or the major ones.

Chairman NUNN. I would say on the major programs it would be helpful. What we really need is a grasp of what this program is doing that would not otherwise be done if there was not such a program.

Is it worthwhile? We felt at the time we had to put more money into conventional. We felt that, as Senator Cohen has already said, that SDI was just drawing off all the funds and we were being depleted in terms of innovative technology.

So we need to answer now, now that we have done this, is it worth keeping? Is this approach worth keeping? Is there a better way to do it? The fact that it came out of this committee does not mean it is sacred and we are going to keep it forever. If it is doing a good job, we want to know about it. But we have to have examples.

Senator COHEN. Let me just read the report again that we filed at that time. It says, "Therefore the committee expects to receive a detailed report on the program he selects, their prior and enhanced funding levels, their prior and enhanced funding profiles for the current FYDP and a set of major milestones and dates against which the Congress will be able to measure progress under the initiative."

That is the language of the law that was passed and we do not have any of that.

Dr. DUNCAN. We have provided two detailed reports to date that provide most of that information.

Chairman NUNN. Maybe it is time to fold this into something else. Maybe it makes more sense to do it another way. Senator Bingaman's subcommittee is going to be exploring those.

At the time we did this, we felt it was very justified and the committee and the Congress obviously did. I think it has done some good that we put more emphasis on conventional, much more than we would have otherwise. Do you agree with that?

Dr. DUNCAN. Absolutely. I think it has done an enormous amount of good and I have not articulated as much good as the program has done. I would urge the committee to continue the program either in the present structure or some structure.

Chairman NUNN. You are speaking for the Department now, on that?

Dr. DUNCAN. I am speaking for the Department, yes. That we continue the BTI program.

Chairman NUNN. How do the services feel about it?

Dr. DUNCAN. I would expect that the services would all be supportive of the BTI program.

Chairman NUNN. If there are better ways, if there are legislative improvements that need to be done, we would like to know about them. We do not want you to feel that the fact that something originated in this committee means that we are locked in forever. I do not approach things that way and I do not think the committee does. We want to know how we can make this money be most effective. That is what we want to know. Senator Bingaman.

Senator **Bingaman**. Senator Levin just arrived.

Chairman **Nunn**. I have been eating into some of your time, though, so why do you not go ahead and then we will come back to Senator Levin.

CRITICAL TECHNOLOGIES

Senator **Bingaman**. Well, let me ask a little bit more general question. I am concerned that because of the way the administration has been gaming the Congress and Congress has been gaming the administration on funding in the R&D area, it is likely that we disrupt the stable and adequate funding level needed in some of these critical technology areas. I will be more specific about that.

A lot of these critical technologies that your office identified for us are ones where the bulk of the money the administration is asking for is in the budget, it is in the SDI account.

Data fusion is one of them. Passive sensors is one of them, pulse power. These are all areas that have both conventional and strategic significance but most of the funding that is asked for by the administration when they come to the Congress each year is in the SDI area.

Of course they ask for a lot more in SDI than they are going to get, the administration does, and everybody knows that. So they come in at $5.6 billion or something in that range, they wind up with $4 billion or something in that range, and those things that get cut are the R&D programs that have dual use.

By that I mean, have use in SDI perhaps, but also have use in the conventional arena, and have use in other areas. I am trying to figure out how we solve that problem here.

The Balanced Technology Initiative provides a source of funds for the—you said 21 of the 22—for follow-on or insertion-type technologies. Does it make sense that we have a program like this which is available more broadly?

Are there limitations on the use of these Balanced Technology funds in the support of critical technologies that we ought to eliminate? I guess that is the real question. Would you feel more comfortable if you had more leeway to use some of those funds to support the development and insertion into weapons systems of critical technologies?

Dr. **Duncan**. I would hate to see the Balanced Technology Initiative, which is directed toward improving conventional war-fighting capability, suffer in any way. I am an advocate of that initiative.

I am also an advocate of advancing the technology in each of these critical technology areas, and there is overlap, as we indicated.

DIGITAL GALLIUM ARSENIDE RESEARCH

Senator **Bingaman**. Let me give you a more specific example. Last year, SDIO was planning to spend over $30 million on digital gallium arsenide research and development. That is what we were advised. Last fall SDIO in fact sent DARPA only $14 million, not the $30 million, for this program.

Earlier this year SDI tried to reduce that another $4 million and I gather they backed off on that. But in fiscal year 1990 they have already cut the planned funding for digital gallium arsenide.

Now, this is number two in this list of critical technologies that you have identified for the Congress. This is not a pork barrel project that the Congress is skewing money toward or away from.

Dr. DUNCAN. Right.

Senator BINGAMAN. If in fact this is the number two critical technology—and I know these are not in the order of importance, but if it is on the list, how can we get a more adequate and more stable level of funding to pursue that research?

Dr. DUNCAN. I have asked myself the same question. Where can we get the resources to support this very, very important gallium arsenide production capability.

I understand the SDI problem. When their funds are cut back, they have to make important judgments about what to drop or what to reduce. That is a way of life for all of us.

Senator BINGAMAN. I guess what I am saying is, their priorities seem to be directly opposite of yours. You are telling me that gallium arsenide is one of the 22 most critical technologies.

My information is that the early applications for gallium arsenide are going to be in the conventional arena, not in the SDI arena. But the bulk of the funding happens to be going through the SDI budget and SDI does not see it as a priority, so they cut it.

Dr. DUNCAN. They see it as a lesser priority than some other things they are doing, yes.

Senator BINGAMAN. How can those of us in Congress who want to just be sure that the money is being spent where the experts tell us it is most needed, how can we be sure that that is done?

I guess what I am driving at is, should we pull those items that are presently in the SDI budget that are also on this list of critical technologies out of the SDI budget and have a separate funding identified for support of critical technologies so that SDI cannot cut it when they look for places to save money as they go through that process each year?

Dr. DUNCAN. Well, that is one route that could be taken. One of the reasons I am hesitating, Senator Bingaman, is there are a lot of people who would debate what are the critical technologies.

There are a lot of people who do not totally agree with this list as being the most critical technologies, and when we were trying to coordinate that particular report through the building, a lot of inputs we received were individual opinion.

So let us assume that one of the things on this list is really not a critical technology compared to something else. But let us assume that you used this list as being sacrosanct and said that so much money should be put into this area, or so much emphasis should be put there. We could be, together, making a mistake if we did that. We have to be very careful.

Senator BINGAMAN [presiding]. My time is up. Let me just say one other thing, then I will defer to Senator Levin. We have never had that explanation given to us for why the funding was being cut in some of these areas. They have never come back and said, this is not a critical area. They have always come back with other kinds of explanations.

Senator Levin. You are in charge.

BTI BUDGET CUTS

Senator **LEVIN**. You are in charge. I will flip you for it.

You may have answered these first few questions, so just let me know and we will check the record on it. As I understand it, the budget that is before us proposes to cut the BTI budget by about $67 billion over the next 2 years and the funding request for fiscal year 1990 is actually higher than it would be for 1991. In other words, 1990 is less than 1989—$67 million. I misspoke. $67 million.

The budget request for 1990 is less than it was for 1989, and the budget request for 1991 is less than it is for 1990. Is that correct?

Dr. **DUNCAN**. That is correct, yes.

Senator **LEVIN**. Now, that is a little unusual because the budget for 1991 is scheduled to be larger than it is for 1990. There is supposed to be some budget growth.

Dr. **DUNCAN**. In the BTI?

Senator **LEVIN**. Yes. No. Overall. There is budget growth proposed overall in the defense budget from 1990 to 1991, and yet in the BTI account there is actually a proposed reduction from 1990 to 1991, as well as there is from 1989 to 1990. I am just wondering, why is that? I can understand why 1990 might be lower than 1989 given the cut this year from last year, but when you have a proposed increase from 1990 to 1991, why would BTI take a cut?

Dr. **DUNCAN**. It is being cut by $5 million out of $200 odd million. It is being cut because the overall profile of the new projects that have been started add up to that reduction.

Now, that is in the budget proposal, that is not in the $206 million and the $201 million figure. The $206 million and the $201 million come from a reduction from a budget that looks like this for the 2 years and it was pulled down. That means that we are going to have to make some decisions how the BTI program is to accommodate those reductions.

Senator **LEVIN**. Have you decided what programs you are going to have to cut in 1990, or eliminate in 1990?

Dr. **DUNCAN**. No, sir, not yet.

Senator **LEVIN**. How do you reach a number like $206 million, unless you know what programs that funds?

Dr. **DUNCAN**. Very frequently, and in this particular case, for the R&D funding levels that involve lots of different projects, cuts are not made on individual projects when the budgets are being adjusted.

R&D budgets are not examined on a detailed project-by-project basis when adjusting a funding figure. When there is a general reduction, it is up to the people to distribute it as best they can.

Senator **LEVIN**. So there are no assumptions in that $206 million figure?

Dr. **DUNCAN**. There are no assumptions in those numbers——

Senator **LEVIN**. As to how much will go for which program?

Dr. DUNCAN. No, sir, there are not. We have yet to do that work and we are waiting for the final numbers before we start. But we know we have a lot of work ahead of us.

ELECTROTHERMAL GUN

Senator LEVIN. A few specific questions on the electrothermal gun, which you made reference to on I think page 6 of your testimony.

Could the availability of a large caliber electrothermal gun allow us to radically redesign our current and anti-armor deficiencies—to improve our current anti-armor position and correct our deficiencies?

Dr. DUNCAN. Yes, it could. It has that potential. We are examining electrothermal guns, we are examining liquid propellent guns, we are examining coil guns and rail guns, all for that potential.

Senator LEVIN. We are not able to tell, for instance, whether that program would be cut under this budget request?

Dr. DUNCAN. You are not able to tell, and I am not able to tell you yet, either, because I would have to examine, with the team of people the status of these programs and make judgments about the potential of the programs based on the progress that is made thus far.

Senator LEVIN. Now, if we markup our budget in July, will you have completed your review of that process?

Dr. DUNCAN. It is not our plan to have it completed by then. We have a more lengthy review process than to have it completed in July. We are looking at the progress of these projects.

Senator LEVIN. When does that process begin, or when does it end?

Dr. DUNCAN. Well, we generally were shooting for the beginning of the next fiscal year so that we know how to apportion things as we begin the next fiscal year.

Senator LEVIN. You actually do not allocate the pie for BTI until the beginning of the fiscal year that you have the pie?

Dr. DUNCAN. We are doing the groundwork for that, but we will not have reached our final decisions until we approach the beginning of the next fiscal year.

Senator LEVIN. Do you reach some kind of tentative decisions before the beginning of the fiscal year on which projects you are going to fund and which ones you cut or eliminate under particular assumptions?

Dr. DUNCAN. The way this has proceeded thus far is, we take this group of people—I believe you were here, Senator Levin, when I described the people who were involved in the review process. It includes all the services, DARPA, representation from the Joint Chiefs and representation from the major program offices of DDR&E.

That particular group of people, in many, many, many hours of examination of each of the projects—and there are advocates for various projects because they are in the individual services—reach some sort of a tentative listing of how they would categorize these projects. Then they are brought to me.

The way we have done it in the past is that they are brought to me and I make the final judgments on which projects to support out of the total list. I do not necessarily choose in exactly the order that they do. I reach my own judgment.

Senator **Levin**. If I can ask one more question beyond my time, you do not make any of those decisions, though, prior to July? You personally?

Dr. **Duncan**. No, sir.

Senator **Levin**. Thank you.

Chairman **Nunn** [presiding]. Thank you. Senator Bingaman.

Senator **Bingaman**. Mr. Chairman, thank you. I will just follow up a little bit, because I think this is a pretty basic question—the one I was trying to pursue a little earlier, using the example of gallium arsenide.

REPROGRAMMING FUNDS

Most of that funding for research in that area comes from the SDI budget. You also can put some money into that and are able to on the conventional side. But if the SDI decides to cut funding, all you can do is try to reprogram some of your funds to make up for what they cut. Otherwise their decision to cut that funding sticks and that program suffers accordingly.

So we have got a situation where what may be a fairly low priority activity for them is primarily funded through their budget.

Dr. **Duncan**. Yes.

Senator **Bingaman**. You may be sitting over here saying, this is really a very high priority activity for the country and for the Department of Defense overall. But since the money is coming through their budget, they have the primary say over whether or not we fund the research.

How do we fix that? I mean, should Congress write a statute saying regardless of where the money comes from, the Secretary of Defense is directed in fiscal year 1990 to spend not less than $60 million in research in the area of gallium arsenide, or whatever the example and the appropriate figure should be, and go right down this list of 22 critical technologies and specify that the Secretary is directed to spend not less than x number of dollars on each?

I mean, is that the only way to get that priority to occur? What do you recommend? I am asking for help in knowing how to deal with the problem because I mean I do take your list as a good, conscientious effort to tell us what is important.

If we take your advice on that and want to see that the things that are important are adequately funded, and funded on a stable basis, so that we do not have starts and stops, how do we get that to happen?

Dr. **Duncan**. Well, I do not think the proper process is for the Congress to say, spend so much money on such and such a technology. I know that is done and has been done and in some cases that may be the proper thing to do, but I think in general that is not the proper thing to do.

Senator **Bingaman**. I tend to agree. I do not like that process either, but I am just wondering, how do we get it done without doing that?

Dr. DUNCAN. I do not have a quick, glib answer to the question because it is a very fundamental question on how we run our R&D business. The R&D business in defense is so broad and involves so many technologies. In those technologies are things that we cannot predict that are going to be the revolution of the future that can upset a balance enormously.

We have seen examples in the past where these have occurred and there will be more examples in the future where they will occur.

Senator BINGAMAN. No, I understand that. But I do think that there are some areas of technology development where we can get a fairly good consensus. These are important areas.

Our allies are pursuing them aggressively, and our potential enemies are pursuing them aggresssively, and we ought to be pursuing them aggressively. If we set our priorities and say, okay, here is a list of 22 of them that are important, are you saying that we do not have the institutional capability to set priorities and fund them in Government?

Dr. DUNCAN. No, I am not saying that. The way things have worked in the past, as imperfect as they have been, they have worked reasonably well. This is through decentralization into the laboratory structure and into the R&D management structure in the various agencies and in the various services, and in SDI. There is a budget for SDI that the President has submitted and I think should be supported. But that budget does not permit as much gallium arsenide work as a larger budget would have permitted.

I think we are making a mistake if we do the following things—I am not answering your question, Senator Bingaman. I guess I do not really know the answer to your question.

But I think for the Congress to specify is wrong. I think to centralize it too much in DOD is wrong. To totally decentralize it is wrong. We need——

SPENDING R&D FUNDS

Senator BINGAMAN. What we tried to do here, and what you tried to do in this report you gave us, was not to try to centrally decide how 100 percent of our research funds are to be spent, but to take less than 20 percent of our research funds and say, what shall we spend this small portion of our research funds on to get the maximum possible benefit? What are the highest priorities?

You know, we recognize that 80 percent of our research funds will be spent just trying to stimulate people to come up with new ideas and pursue a lot of things that we cannot centrally control and should not try to centrally control, but it seemed to me that there is some value in having some national priorities.

I mean, when the Japanese decide they want to pursue new materials development as a technology, and later as an industry, they lay out a plan to do that and pursue it year by year. I think our European allies do the same, and I think to myself it might not be a crazy idea for us to think about.

But here we have got new materials as one of the 22 critical technologies, and I do not know how those of us in Congress can be sure that the funding for research and new materials will be adequate and stable and move us where we need to be over the next 5 years.

Dr. DUNCAN. In the new materials area, there is of the order of $90 million or so work being done in DARPA. I think the DARPA materials research program is one of the things that we collectively can be most proud of, because we have more materials today than——

Senator BINGAMAN. I agree. That is an example where DARPA has done an excellent job and it is not like these ones which are primarily funded through SDI that I am primarily worried about.

Mr. Chairman, my time is up.

Chairman NUNN. Go ahead, Senator Bingaman. I have finished my questions so if you would like to finish.

Senator BINGAMAN. Well, if you have any additional thoughts I will not belabor the point here, but I think I have stated it as best I can.

I do not think the ideal situation is for Congress to specify the level of funding either, but I do think that we have to find a mechanism by which Congress can be confident that we are not going to wind up with unstable and inadequate funding in crucial areas, and that is what I am not persuaded we have as of yet.

Dr. DUNCAN. Yes, I understand.

Senator BINGAMAN. That is all I have, Mr. Chairman. Thank you.

Chairman NUNN. Thank you, Senator Bingaman. Dr. Duncan, Mr. Compton, we appreciate very much you being here and we welcome your further suggestions between now and the time we get our bill marked up, if you have any, along the line we are talking about today. We undoubtedly will have some questions for the record.

Dr. DUNCAN. Yes, sir. Thank you.

Chairman NUNN. Thank you very much.

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR SAM NUNN

SELECTION OF NUNN AMENDMENT PROJECTS

Chairman NUNN. In April 1988, Mr. Dennis Kloske, the Deputy Under Secretary of Defense for Planning and Research, testified before the Armed Services Committee that there were four areas in which the Defense Department needed to focus in the near term in order to maintain momentum behind the cooperative R&D program. The fourth area that he mentioned was the need to be more selective in choosing more ambitious programs that meet NATO's priority requirements.

There are now 26 cooperative R&D projects underway. I understand that the Defense Department has recently authorized the military services to negotiate memoranda of understanding for 27 more projects. Even if only half of these new projects are finally implemented, is approval of this large number of new projects consistent with Mr. Kloske's point about being more selective in choosing more ambitious programs?

Mr. COMPTON. I strongly feel that the greatest potential payoffs from cooperative R&D efforts do indeed lie in ambitious projects and as Secretary Cheney recently testified to this committee, with the most technologically advanced allies. Such programs are likely to realize the greatest savings from avoiding large potentially-duplicative R&D costs. Moreover, such partners are likely to be those who can bring their own advanced technologies as contributions to a cooperative program, to have the economic resources to sustain the role of an equitable partner in a high-payoff development program, and to have the industrial capability to translate the result of a cooperative development into the hardware for improved common defense.

We therefore naturally continue to seek out such ambitious programs as candidates for cooperative development, but for two general reasons have not meanwhile, excluded more modest programs from consideration. First, we believe that a likely determinant of a project's success is its match to the scale of requirements and level of capabilities of the prospective partner; we have found cooperation to be useful along a wide spectrum of program size and technology level. Second, a general theme of the Nunn-Roth-Warner initiative was to increase awareness of the potential benefits from cooperation, and to set forces in motion which would result in an increasing level of cooperation among the U.S. and our allies. Steady growth in the number of programs is a natural byproduct, and ought to be seen as some measure of the initiative's success.

Chairman NUNN. Does each of these 27 new projects satisfy at least one of the key conventional deficiencies that have been formally agreed upon by the NATO alliance or one of the highest priority needs ("Band A") of the Conceptual Military Framework prepared by the Supreme Allied Commander in Europe?

Mr. COMPTON. While the final selection process of new projects has not been completed, and some further winnowing of the list may be expected, all projects certified will address at least one of these deficiencies or needs. Of course, it is not realistic to expect any individual program to fully "satisfy" such broadly-stated needs.

FUNDING FOR THE NUNN AMENDMENT

Chairman NUNN. The Armed Services Committee has strongly supported a consistent, stable level of funding for the cooperative research and development program. The authorization and appropriations processes have annually provided about $200 million and $150 million, respectively. On the other hand, the Defense Department's annual request for the program has fluctuated quite a bit.

Do you agree that the benefits of the program would be maximized by a regular, predictable level of funding?

Mr. COMPTON. Absolutely. Such predictability would improve all aspects of management of the program, as well as enabling improved planning by the services and Defense Agencies. It would also enhance the U.S. reputation as a reliable partner.

Chairman NUNN. If there were no constraints on the defense budget, what would be the most effective and manageable level of funding for the cooperative research and development program?

Mr. COMPTON. Ironically, in such a fiscally unconstrained environment for the entire defense budget the need and very likely the effectiveness of the cooperative R&D program would be sharply reduced; it is the fiscal constraint itself which makes the program go.

In the even-more-hypothetical circumstance of a defense budget severely constrained like today's, but without constraint on the amount of the cooperative R&D funds, our experience suggests that funding levels on the order of this committee's historical authorizations have been effective and manageable. Especially if stable and predictable, some continued real growth from that level could probably be effectively programmed.

COOPERATIVE AND CLASSIFIED PROGRAMS

Chairman NUNN. How does the Department of Defense ensure that a cooperative program is not made obsolete before it is fielded by a highly classified program that the U.S. might be carrying out by itself?

Mr. COMPTON. The process of project selection includes thorough review by service and OSD staffs, where such possible redundancy should be detected and (generally) eliminated. However, my earlier remarks about a spectrum of possible partners, as well as the potential for a program to target areas of allied technology, suggest that there may be occasions when some apparent redundancies should not be completely excluded from consideration.

[Whereupon, at 3:46 p.m., the hearing was adjourned.]

DEPARTMENT OF DEFENSE AUTHORIZATION FOR APPROPRIATIONS FOR FISCAL YEARS 1990 AND 1991

TUESDAY, JUNE 20, 1989

U.S. SENATE,
COMMITTEE ON ARMED SERVICES,
Washington, DC.

DEPARTMENT OF DEFENSE UNIVERSITY RESEARCH PROGRAM

The committee met in open session, pursuant to notice, at 2:12 p.m., in room SR-222, Russell Senate Office Building, Senator Sam Nunn (chairman) presiding.

Committee members present: Senators Nunn, Exon, Levin, Bingaman, Dixon, Gore, Warner, Thurmond, Gorton, and Lott.

Committee staff members present: Arnold L. Punaro, staff director; Andrew W. Effron, general counsel; and Kathryn E. Bognovitz, special assistant.

Professional staff members present: David S. Lyles and William H. Smith.

Minority staff members present: Patrick A. Tucker, minority staff director and counsel; Romie L. Brownlee, deputy staff director for the minority; Jonathan L. Etherton, George W. Lauffer, and Ann Elise Sauer, professional staff members.

Staff assistants present: Barbara L. Braucht, Lori M. Jackson, and Melissa A. Ramsey.

Committee members' assistants present: Jeffrey B. Subko, assistant to Senator Exon; Kenneth N. Luongo, assistant to Senator Levin; William J. Lynn, assistant to Senator Kennedy; Edward M. McGaffigan, Jr., assistant to Senator Bingaman; Charles C. Smith, assistant to Senator Dixon; Milton D. Beach, assistant to Senator Glenn; Leon S. Fuerth, assistant to Senator Gore; Terrence M. Lynch, assistant to Senator Shelby; Dudley L. Carlson, assistant to Senator Wilson; Anthony H. Cordesman, assistant to Senator McCain; Robert M. Soofer, assistant to Senator Gorton; Charles G. Pearcy, assistant to Senator Lott; and Eric H. Thoemmes, assistant to Senator Coats.

OPENING STATEMENT OF SENATOR SAM NUNN, CHAIRMAN

Chairman NUNN. The committee will come to order.

We were running late in the Democratic caucus. I think the Republicans have a similar problem, but they have sent word they would like for us to go ahead and start. So, we will begin this afternoon. I am sure we will have other members joining us.

The Armed Services Committee meets this afternoon to continue our oversight of the Department of Defense's University Research Program and related issues. Our committee has been a strong supporter of the Department of Defense basic research programs. These programs are part of the foundation of America's future, both in terms of our defense and our national economic security.

At the beginning of the last Congress, the committee created the Subcommittee on Defense Industry and Technology chaired by Senator Bingaman, who is with us here today, with one of the primary objectives to improve our defense technology base. Over the past several years, the committee approved increases above the administration budget request for basic defense research programs, primarily under the guidance and urging of Senator Bingaman who has done an outstanding job in this area.

The committee also recognizes the key role that our colleges and universities play in maintaining the Nation's defense and world leadership in science and technology. In recent years, one of the trends and in the view of many people one of the impediments to the Department's execution of a sound research program in our colleges and universities has been the practice of earmarking, that is, designating a particular project for a specific college or university outside of the normal competitive peer review process. Specific earmarking does take place in Congress, in fact, increasingly so. But it also occurs, maybe more subtly, in the executive branch when the Department takes a purely sole-source approach to fund some of its longstanding research and development organizations and programs.

Every time there is a successful attempt to earmark funds for a particular university or college, scarce funding is unavailable to those competing in the merit selection system. And every successful attempt to earmark makes it all the more difficult for those institutions and Members of Congress that currently resist this practice to not use the same approach for their particular institution of choice.

The current distribution of defense research programs through the university structure is a second problem. Many of the universities and colleges currently involved in defense research activities are performing outstanding work and, of course, we should continue to support them. But I also believe we need to provide an opportunity for those schools that are not currently participating in DOD programs that have the capability.

There is much talent in the Nation's higher education infrastructure that should be tapped. We must ensure that these institutions that have the capability have the same opportunity to compete and participate as those that currently are involved in the programs, some of whom have a real sole-source advantage either due to earmarking or DOD practice.

Last year the Defense Authorization Act attempted to deal with both of these problems. One provision of the act directed use of competitive procedures for all university research contracts and grants beginning in fiscal year 1990. A second provision directed the Department to provide a plan describing how University Research Initiative (URI) programs will be more broadly distributed throughout the Nation's universities and colleges. The intent of these two provisions was to provide a two-track approach by providing funding for quality research while at the same time improving the overall infrastructure of the Nation's graduate science and engineering education programs.

We will hear from two panels of witnesses this afternoon. Our first panel is Dr. Robert Duncan, Director of Defense Research and Engineering at the Department of Defense. Dr. Duncan has responsibility for all university research activities funded by the Pentagon, as well as many other responsibilities.

Our second panel includes two distinguished witnesses from the scientific and academic community. Dr. Frank Press is the President of the National Academy of Sciences and formerly served as science adviser to the President. Mr. Joe Wyatt is the Chancellor of Vanderbilt University and will provide his perspective as the head of a major university involved in defense supported research. I also understand he will be wearing the hat on behalf of the 59 institutions represented by the American Association of Universities.

We want to make it clear to our witnesses here today that even though these two provisions were put in by our committee, we are not locked into them. If there are suggestions for ways we can make changes, if there are adjustments that need to be made, certainly I believe our committee would be receptive to that.

Senator Bingaman, I know you have taken a real lead in this, and I would welcome any comments you may have. I know Senator Warner will be in in a few minutes and will have his own comments.

Senator BINGAMAN. Mr. Chairman, I do not have an opening statement.

I do compliment you for holding the hearing. I know you have had a continuing interest in this and have fought the good fight to try to ensure that the funds we do have in this area are awarded on the basis of where the work can best be accomplished.

I think that we have several goals that we are trying to pursue here, and sometimes they come in conflict. One, of course, is to ensure that the best possible research activity takes place. Another is to maintain and build the university research infrastructure in our country which has been such a vital part of the scientific progress that we made. And I hope that we can sort it out here and see to it that if changes are needed in the way that funds are allocated, we can make those this year.

Thank you.

Chairman NUNN. Thank you.

We have prepared statements by Senators Dixon, Warner, and Thurmond which shall be made a part of the hearing record.

[The prepared statements follow:]

PREPARED STATEMENT BY SENATOR ALAN J. DIXON

I am pleased to welcome our distinguished witnesses who are here to testify about the status and plans concerning the Defense Department's university research programs. The testimony given here today will aid this committee in deliberating this year's Defense authorization bill, which we will be marking up in the next few weeks.

I certainly support this program of conducting defense-related research at our universities. Along with my colleagues on the Armed Services Committee, I have supported a funding increase for these programs year after year. I have backed these increases because this program is part of an effort to build the strong industrial and technology base that this country needs.

I want to emphasize, however, that funds for these programs should be authorized and appropriated based on the merit of the program and not on pork-barrel politics. Moreover, funding decisions should be based on clear, well defined requirements. There is no room in this tight budget environment to fund programs that lack merit and have ill-defined our unsubstantiated requirements.

Last year this committee included a provision which allows the Defense Department to obligate or expand research initiative program funds within a State without limitation, a change from the previous year. I look forward to hearing how this provision has improved the overall performance of this program and I thank the witnesses for appearing before this committee.

PREPARED STATEMENT BY SENATOR JOHN WARNER

Mr. Chairman, I want to commend you for calling this hearing and I join you in welcoming our witnesses this afternoon. We continue to struggle with the question of the role of Congress and of the members of this committee in allocating defense funds for research to universities and other institutions of higher learning.

There are a number of interrelated issues that must be sorted out. First is the issue of earmarking. This committee, under your leadership Mr. Chairman, has taken a strong position against earmarking defense research funds to specific universities in lieu of using the competitive process. In the Defense Authorization Act for fiscal year 1989, the House and Senate Armed Services Committees mandated in statute that such research funds be competed. The Nunn-Warner-Danforth amendment to the Defense appropriations bill in the waning hours of September 30, 1988 struck out specific earmarking of funds in that legislation despite significant opposition from some of our colleagues.

The issue of earmarking is closely related to the issue of the adequacy of the peer review process in the Department of Defense for awarding funds competitively. Last year, we directed the Department of Defense to use $25 million in the University Research Initiative program to attempt to increase the base of participating institutions. However, if the perception in the academic community persists that the system is somehow rigged in favor of well-established, large universities with multi disciplinary programs, the pressure for earmarking will continue.

This committee must continue to oversee the policy goals for university research as well as the process for distributing the funding. We can only succeed, however, if the Department of Defense and the academic community work with us in a shared policy framework. This hearing will serve as an important stage in building that partnership.

PREPARED STATEMENT BY SENATOR STROM THURMOND

Thank you Mr. Chairman. I join you in welcoming Mr. Duncan back before the committee. His appearance last week to testify on the Balanced Technology Initiative was very enlightening and I expect that today we will benefit from his extensive knowledge of the university research program.

I know my colleagues on this committee will agree with me that the United States and the Defense Department must encourage our academic institutions to maintain a strong research program. The University Research Initiative and similar programs sponsored by the Federal Government are essential in this endeavor. Without Federal funding, our colleges and universities could not devote the resources to those multi-disciplinary fields of research that are essential to our Nation in both defense and commercial applications.

To get the most benefit from the dollars that we commit to the University Research Initiative and similar programs, we have to ensure that there is competition. Competition fosters initiative and innovation, both of which are critical to research.

Mr. Chairman, I support your efforts and those of the other members of this committee in rejecting the practice of designating specific institutions as beneficiaries for funding under the University Research Initiative. This practice, although politically beneficial, is not always in the best interest of scientific research or our Nation.

Thank you Mr. Chairman.

Chairman NUNN. Dr. Duncan, we are pleased to have you today, and I know you have an opening statement. We will be pleased to receive it.

STATEMENT OF DR. ROBERT C. DUNCAN, DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING, U.S. DEPARTMENT OF DEFENSE

Dr. DUNCAN. Thank you, Mr. Chairman. I have a statement I would like to enter into the record, and I would like to summarize that statement verbally if I may.

Chairman NUNN. Fine. Without objection, your entire statement will be a part of the record.

Dr. DUNCAN. The Department of Defense has supported research and development at academic institutions for almost five decades. The research offices of the services and the Defense Advanced Research Projects Agency (DARPA) were among the first Federal organizations created in the period immediately after World War II to foster science and engineering research in the Nation's universities.

In addition, universities in the World War II era and the immediate post-war period established a small number of highly specialized laboratories to perform defense development as well as research. These organizations, which bear some resemblance to the Department of Energy national laboratories, are generally separate and distinct from the academic side of the university and account for virtually all of the DOD's development funding awarded to academic institutions.

DOD's support of research and development, performed by the universities and others, is best understood in the context of the overall Federal support. We provide about 9 percent of the overall Federal support for basic research and about 25 percent of Federal support for applied research. DOD represents about 45 percent of the total support for research in engineering at academic institutions, thereby facilitating the transition of research results to application.

Other agencies dominate funding in other fields, and this results in differing geographic distributions for different agencies, a factor of significance relative to consideration of overall geographic balance.

I would like to talk first about our basic research programs. University participation is central in three of DOD's four research programs, that is, the 6.1 programs, namely, Defense Research Sciences, DRS; the Defense University Research Instrumentation Program, DURIP; and the University Research Initiative, URI. I would like to talk briefly about each of these.

Defense Research Sciences [DRS]. The annual DRS funding has approached $800 million in recent years, and under competitive processes, universities have been awarded about half of that amount. Primary emphasis is on projects in which one professor is assisted by a small group of post-doctoral scholars and graduate students. Research results are produced across a broad spectrum of fields important to national defense.

Average awards under DRS are typically $100,000, and some 4,000 faculty researchers are supported in about 275 institutions in 50 States and the District of Columbia.

The Defense Instrumentation Program [DURIP] was began as a DOD initiative and has provided a total of $172 million for university research instruments between fiscal year 1983 and fiscal year 1988. The program is not funded in fiscal year 1989 nor in the budget request for fiscal year 1990, but the Army and DARPA have included instrumentation programs like DURIP beginning in fiscal years 1991 and 1992 within their 5-year plans for the University Research Initiative.

These programs complement DRS by providing funding for major instruments and help to build new defense research capabilities among researchers and institutions that are not yet participants in our research program.

The DURIP program has had a broad impact. There have been more than 1,200 instrumentation awards made at more than 175 academic institutions in 48 States, including the District of Columbia and Puerto Rico.

In fiscal year 1988, more than 20 percent of the DURIP funds were awarded to institutions which had not been major participants in Federal research programs in recent years. Some 6 percent of the fiscal year 1988 awards were made to historically black colleges and universities and other minority institutions.

The University Research Initiative [URI] is the third research program in 6.1 in which universities participate. The core of this program is multidisciplinary research, but as originally conceived, URI included graduate fellowship programs, awards for young faculty investigators and scientific personnel exchange programs with the DOD labs.

In response to a congressional request accompanying the Defense Authorization and Appropriations acts for Fiscal Year 1989, DOD submitted, to the House and Senate Armed Services Committees, plans for increasing the URI activities to broaden geographically the research base and build a research infrastructure nationwide. The 5-year plan we submitted to Congress will reduce URI's original emphasis on multidisciplinary research from 90 percent to about 60 percent by fiscal year 1993.

As the first phase in this transition of URI, DOD began the new research initiation program at $5 million this year, fiscal year 1989. To achieve the requested geographic broadening, we specifically competed the program among institutions that were not major participants in our research programs in recent years, including Historic Black Colleges and Universities and other minority institutions. Some 38 awards were made to 32 academic institutions in 22 States and the District of Columbia. We plan to increase this new research initiation program to 15 percent of URI by fiscal year 1991.

In my written statement, I have also included information on our support of graduate students, through both our research and fellowship programs. The total number of graduate students supported by the DOD is 8,000 students.

I would like to talk briefly about our selection process. Almost without exception, DOD funding of university research is conducted through merit competition. Long before Congress enacted the Competition in Contracting Act [CICA] DOD followed competitive procedures in soliciting and awarding contracts and grants for university research. Even though the CICA requirements do not apply to grant instruments, DOD research grants are also awarded through a competitive process.

Each year the research offices of the services and DARPA publish summaries of their research interests in the "Commerce Business Daily" and in detailed form in brochures called broad area announcements. I have here a collection of broad area announcements or BAA's put out by various organizations within the DOD that we can make available to the committee.

These BAA's are sent to researchers, sponsored program officials, and scientific and engineering department heads of colleges and universities located in all 50 States. This process is used to advertise both the ongoing research programs of the services and DARPA, as well as to request proposals for special programs, such as the University Research Initiative, the Defense University Research Instrumentation Program and most recently the Research Initiation Program.

In all cases, BAA's contain detailed descriptions of each scientific and engineering discipline for which DOD offers support, names of persons who may be contacted for further information, instructions for preparing and submitting proposals, and proposal evaluation criteria and procedures.

Proposals received are evaluated and selected for funding based on a number of criteria, the two principal ones being the scientific and technical merit of the research proposed and the potential relationship to a military function or operation. The latter requirement is statutory and is derived from the Mansfield amendment, which was enacted in 1970. Thus, in practice our funding decisions must weigh both technical quality and potential military relevance.

Last, I would like to discuss setasides which you brought up in your opening statement, Mr. Chairman.

Since fiscal year 1986, DOD has been directed by statute and in report language to award noncompetitively approximately $300 million in university grants for research and facilities construction.

Chairman NUNN. Are you using the term "setasides" the way I use the term "earmarking?" Is that the same?

Dr. DUNCAN. Yes, sir, I am.

Moreover, DOD is not the only Federal agency so affected. According to the "Chronicle of Higher Education," Federal-wide setasides totaled more than $225 million in fiscal year 1988 and $290 million in fiscal year 1989. Others have estimated that as much as $900 million have been earmarked in various Federal appropriations bills since fiscal year 1980 for at least 300 academic research and construction projects. It is not clear, however, that earmarking of funds for such purposes has brought about improvements in the distribution of funding for such research and facilities modernization, nor has it had the effect of improving the quality of federally sponsored research.

Statutory earmarks present DOD with conflicting statutory directions. Some earmarks have required the funding of projects which DOD could not have separately justified under the Mansfield amendment. Besides the Mansfield amendment, statutory earmarks are in conflict with CICA provisions specifying merit competition. Consequently, DOD officials are frequently faced with contradictory statutory requirements, the earmark on the one hand and requirements for merit competition and military relevance on the other.

The Department of Defense opposes the practice of earmarking. Nevertheless, when setasides are directed by statute, the Department has no alternative but to honor them. Such statutory setasides for specific performers are awarded as directed by the law, and the statute is cited in the grant instrument. However, when statutory setasides call for specific purposes but fail to designate the performers, it has been DOD policy to make awards using competitive procedures.

Nonstatutory direction to undertake particular projects are evaluated by a program staff to determine whether a DOD requirement exists. If requirements for such activities exist and are of sufficient merit to displace other programs, awards are made using competitive processes.

Nonstatutory directions to provide continuation funding for projects which resulted from earmarking in prior years are also evaluated by program staff to determine their merit and contribution to meeting DOD requirements. Renewal decisions on these projects are based solely on these technical-merit and military-relevance considerations.

In summary, Mr. Chairman, for almost half a century the Department has enjoyed a most valuable and productive research relationship with the Nation's academic institutions, and this relationship has been firmly grounded both in DOD relevance and in the merit competition process. We appreciate the constructive efforts of your committee and others to seek means for strengthening this relationship in the future.

[The prepared statement of Dr. Duncan follows:]

STATEMENT BY

DR. ROBERT C. DUNCAN
DIRECTOR DEFENSE RESEARCH AND ENGINEERING
DEPARTMENT OF DEFENSE

Mr. Chairman and Members of the Committee:

I am pleased to testify on behalf of the Department of Defense (DoD) on our efforts to strengthen the participation of the nation's universities in our basic research programs. Today, I understand that you particularly wish me to address the distribution of DoD university research funding and the issue of earmarking of research and construction funds for specific institutions.

UNIVERSITY PARTICIPATION IN DEFENSE R&D

The Department of Defense has supported research and development (R&D) at academic institutions for almost five decades. The research offices of the Services and DARPA were among the first federal organizations created in the period immediately after World War II to foster science and engineering research in the nation's universities. This research activity is conducted primarily within universities' academic departments.

In addition, universities in the World War II era and the immediate post-war period established a small number of highly specialized laboratories to perform defense development, as well as research. These organizations, which bear some resemblance to the Department of Energy (DoE) National Laboratories, are generally separate and distinct from the academic side of the universities, and account for virtually all of DoD's development funding awarded to academic institutions.

DoD's support of research and development, performed by universities and others, is best understood in the context of overall federal support. For example, the following estimates of FY 1988 obligations were reported recently by the National Science Foundation:

CATEGORY	DoD	TOTAL FEDERAL
Basic Research (DoD's Research or 6.1 funds):		
Total (All Performers):	$ 885M	$9,623M
Academic Institutions:	$ 497M	$ 4,927M
Applied Research (DoD's Exploratory Development or 6.2 funds):		
Total (All Performers):	$ 2,320M	$ 9,241M
Academic Institutions:	$ 266M	$ 2,124M
Development:		
Total (All Performers):	$33,338M	$39,648M
Academic Institutions:	$ 304M	$ 720M

As you can see from the table, DoD provides about 9 percent of overall federal support for basic research, about 25 percent of federal support for applied research and 84 percent of the federal total for development. Of the portion of federal R&D performed within academic institutions and their affiliated laboratories (excluding university-administered Federally Funded Research and Development Centers (FFRDC's)), DoD accounts for about 10 percent of federal funding for basic research, 13 percent for applied research and 42 percent for development. While DoD plays a substantial role in overall federal support for development at university-affiliated laboratories, it plays a more modest role within federal support for academic research.

DoD's role is larger within some research fields than the overall figures might lead one to expect. For example, DoD represents about 45 percent of total federal support for research in engineering at academic institutions. This is significant because engineering is often the key to transitioning research results to practical application for both military and commercial purposes. Other agencies dominate funding in other fields. For example, the National Institutes of Health provides about 86 percent of federal funding for life sciences research at academic institutions, whereas DoD represents only 1 percent.

This difference in disciplinary emphases among the agencies indirectly creates differences in geographic distributions of the agencies' university research funding, because different states' universities exhibit strengths in different disciplines. Consequently, one might wish to consider all federal agencies at once when addressing the issue of geographic distribution of university research, so as to capture the full range of disciplines.

BASIC RESEARCH PROGRAMS

University participation is central in three of DoD's four Research (6.1) programs, namely Defense Research Sciences, the Defense University Research Instrumentation Program, and the University Research Initiative. The fourth Research program, In-House Laboratory Independent Research, allows DoD laboratory directors flexibility to address promising new opportunities speedily as they arise.

Defense Research Sciences (DRS): Annual funding for the DRS program has approached $800 million in recent years, and, under competitive processes, universities have been awarded about half of that amount. Primary emphasis is on traditional single-investigator efforts, in which one professor is assisted by a small group of postdoctoral scholars and graduate students.

The DRS program has numerous payoffs. First, for several decades the program has produced significant research results across a broad spectrum of science and engineering disciplines important to national defense. Second, the program supports about 4,000 graduate students pursuing advanced degrees in science and engineering. Moreover, about 10-15 percent of single-investigator funding typically has been spent for state-of-the-art research equipment, thereby strengthening further the university research infrastructure.

Opportunities exist annually for new researchers to become involved in DRS activity. Proposals selected for support generally are funded for 3 to 5 years, as research by nature is a long-term activity. In periods of stable budgets, about 25 percent of program funding is available for "new starts" each year, somewhat less in periods of declining budgets and somewhat more in periods of expansion. In 1990, for example, we estimate that about 17 percent of the program will be in "new starts."

DRS efforts generally are unidisciplinary, and the average award is about $100 thousand, a figure that varies from discipline to discipline. Through DRS, DoD typically supports about 4,000 faculty researchers annually in about 275 institutions in 50 states and the District of Columbia.

Defense University Research Instrumentation Program (DURIP): The DURIP, begun as a DoD initiative, provided a total of $172 million for university research instruments between FY 1983 and FY 1988. The program is not funded in FY 1989 and is not in the budget request for FY 1990 but the Army and Defense Advanced Research Projects Agency (DARPA) have included instrumentation programs like DURIP, beginning in FY 1991-1992, within their five-year plans for the University Research Initiative.

These instrumentation programs complement the Defense Research Sciences program in at least two ways. First, they provide funding for scientific equipment separately from DoD research awards. Instrumentation is the second most important element of research infrastructure, after the human resources of the researchers themselves. Separate instrumentation awards can help to build new defense research capabilities among researchers and institutions that are not yet participants in our research programs.

Second, these programs complement DRS by providing funding for major research instruments, those typically costing upwards of $50,000. In a DRS single-investigator award, 10-15 percent of the $100,000 award typically would be budgeted for instruments. This does not enable researchers to purchase major, state-of-the-art instruments needed to sustain research at the cutting edge in many physical science and engineering fields most important to DoD.

The DURIP program had broad impact. Between FY 1983 and FY 1988, more than 1200 instrumentation awards were made at more than 175 academic institutions in 48 states, the District of Columbia, and Puerto Rico.

In FY 1988, as requested by Congress, DoD increased DURIP's emphasis on development of new research capabilities and the broadening of the university research base. Specifically, we advertised our intention to award 15 percent of the program to institutions that had not been major participants in Federal research programs in recent years, including historically Black colleges and universities (HBCU's) and other minority institutions.

In the judgment of some of our program managers, these institutions responded by submitting a greater number of high quality proposals than we had become accustomed to seeing in response to DoD research solicitations. We exceeded the 15 percent goal we set in the solicitation by awarding more than 20 percent of the FY 1988 DURIP funds to institutions receiving the special consideration, including 6 percent to HBCU's and other minority institutions.

University Research Initiative (URI): The URI is the third Research (6.1) program in which universities participate. URI has a number of facets, but the core of the program is research conducted by multidisciplinary teams, complementing the single-investigator efforts within Defense Research Sciences.

The multidisciplinary approach can accelerate research progress in areas best suited to team effort. Also, it may facilitate the transition from basic to applied research, thereby hastening translation of discoveries to practical application.

In addition to multidisciplinary research, the URI, as originally launched, included graduate fellowship programs and faculty development programs, including awards for young faculty investigators and scientific personnel exchange programs with DoD[9] laboratories. URI supports about 1000 graduate students. Through the multidisciplinary research and exchange programs, URI also has fostered linkages between the university sector and DoD laboratories, resulting in collaborative research and joint publications.

In response to Congressional requests accompanying the authorization and appropriations acts for FY 1989, DoD submitted to the committees plans for increasing URI activities to broaden geographically the research base and build infrastructure nationwide. The 5-year plan we submitted to Congress will reduce URI's emphasis on multidisciplinary research from its original 90 percent in FY 1986-1987 to 60 percent by FY 1993.

As the first phase in this transition of URI, DoD began the new Research Initiation Program within URI at $5 million this year. We announced last month that 38 proposals from 32 academic institutions in 22 states and the District of Columbia were selected in the first competition under the program. Selectees included 24 institutions and 8 states that were not participating in the multidisciplinary URI core efforts. We plan to increase the new initiation program to 15 percent of URI by FY 1991 if initial results so warrant, creating a program with new starts each year.

To achieve the requested geographic broadening, we specifically competed the program among institutions that were not major participants in DoD research programs in recent years, including HBCU's and other minority institutions. This is similar to the approach we used in competing the research instrumentation program in FY 1988, as I described earlier in my testimony.

Awards under the new program are of 3-year duration. The awards emphasize human resources but also have greater emphasis on instrumentation than our typical single-investigator awards. We think local commitment is important in building new research capabilities and we are giving priority under the program to proposals offering cost-sharing.

SUPPORT OF GRADUATE STUDENTS IN SCIENCE AND ENGINEERING

Graduate education in science and engineering (S&E) is inextricably interwoven with university research in those fields. In many non-S&E fields, tuition, fees and living expenses are the major costs of education for students pursuing advanced degrees. By contrast, these are typically one-quarter or less of the cost of education for a science or engineering student pursuing an advanced degree, especially in the physical sciences and engineering fields most important to DoD. The major costs generally are associated with the research required for the advanced degree and can include expensive equipment and operating expenses for experimentalists or computer time for numericists, for example.

In that very real sense, the $763 million DoD invested in both basic and applied academic research in FY 1988 also was invested in support of graduate students in science and engineering. Through these Research (6.1) and Exploratory

Development (6.2) programs, DoD supports approximately 8,000 graduate students in science and engineering, principally through research assistantships funded by research grants and contracts. The total also includes about 500 graduate fellowships supported by 6.1 funding this year. That includes about 120 students who will begin graduate study this fall under the National Defense Science and Engineering Graduate Fellowship program, a program established by statute in this year's appropriations act.

It is important that these fellowships, one valuable component of our broad support of graduate students, be considered in that overall context. This is particularly true since the major cost of education for those fellows, the cost of their degree-related research, is not borne by the fellowship, but by separate research grants and contracts.

DoD SELECTION AND AWARD PROCESS

Almost without exception, DoD funding of university research is conducted through merit competitions. Long before Congress enacted the Competition in Contracting Act (CICA), (P.L. 98-369), DoD adhered to competitive procedures in soliciting and awarding contracts and grants for university research. Even though the CICA requirements do not apply to grant instruments, DoD research grants are also awarded through a competitive process.

Each year, the research offices of the Services and DARPA publish summaries of their research interests in the Commerce Business Daily (CBD), and in detailed form in brochures called

Broad Area Announcements or BAA's. These BAA's are sent to researchers, sponsored program officials and scientific and engineering department heads of colleges and universities located in all 50 states. This process is used to advertise both the on-going research programs of the Services and DARPA, as well as to request proposals for special programs, such as the University Research Initiative, the Defense University Research Instrumentation Program, and our new Research Initiation Program.

In all cases, BAA's contain detailed descriptions of each scientific and engineering discipline for which DoD offers support, names of persons who may be contacted for further information, instructions for preparing and submitting proposals, and proposal evaluation criteria and procedures. In addition to publishing formal announcements, DoD representatives make special efforts to advertise research opportunities at technical meetings and research symposia and at the conferences of high education associations and special interest organizations such as the National Association for Equal Opportunity in Higher Education (NAFEO), among others.

Proposals are evaluated and selected for funding based on a number of criteria, the two principal ones being the scientific or technical merit of the research proposed and the potential relationship to the DoD mission. The requirement for relevance to the DoD mission is statutory, and is derived from the Mansfield Amendment which was enacted in 1970. The Mansfield Amendment (section 204 of P.L. 91-441) stipulates that: "None of the funds authorized to be appropriated to the Department of Defense by this or any other Act may be used to finance any research project or study unless such project or study has, in the opinion of the Secretary of Defense, a potential relationship to a military function or operation."

It is important to note that this requirement circumscribes the type of research DoD may fund. Unlike the National Science Foundation, which has as its mission the support of research and the nationwide research infrastructure across the broad spectrum of science and engineering disciplines, DoD must focus its support in those disciplines which have a potential relationship to a military function or operation. Because funding decisions must weigh both technical quality and military relevance, research which is scientifically excellent, but of no relevance to DoD, cannot be approved for funding, but neither can work addressing DoD-relevant issues in technically inferior ways.

SET-ASIDES FOR UNIVERSITY RESEARCH AND CONSTRUCTION

Since FY 1986, DoD has been directed by statute and in report language to award non-competitively approximately $300 million in university grants for research or facilities construction.

Moreover, DoD is not the only federal agency affected: according to the Chronicle of Higher Education, federal-wide set-asides totaled more then $225 million in FY 1988 and about $290 million in FY 1989. Others have estimated that as much as $900 million have been earmarked in various federal appropriations bills since FY 1980 for at least 300 academic research and construction projects. It is not clear, however, that earmarking of funds for such purposes has brought about improvements in the distribution of funding for research and facilities modernization.

Statutory earmarks present DoD with conflicting statutory directions. Some earmarks have required the funding of projects which DoD could not have separately justified under the Mansfield Amendment. Besides the Mansfield Amendment, statutory earmarks are in conflict with CICA provisions specifying merit competition. Consequently, DoD officials are frequently faced with contradictory statutory requirements -- the earmark on the one hand and on the other hand, requirements for merit competition and military relevance.

The Department opposes the practice of earmarking. Nevertheless, when set-asides are directed by statute, the Department has no alternative but to honor them. Such statutory set-asides for specific performers are awarded as directed by the law, and the statute is cited in the grant instrument. However, when statutory set-asides call for specific purposes, but fail to designate performers, it has been DoD policy to make awards using competitive procedures. Non-statutory directions to undertake particular projects are evaluated by the program staff to determine whether DoD requirements exist; if requirements for such activities exist, and are of sufficient merit to displace other programs, awards are made using competitive processes. Non-statutory directions to provide continuation funding for projects which resulted from earmarking in prior years are also evaluated by program staff to determine their merit and contribution to meeting DoD requirements; renewal decisions on these projects are based solely on these technical-merit and military-relevance considerations.

In summary, for almost half a century the Department has enjoyed a most valuable and productive research relationship with the nation's academic institutions, and this relationship has been firmly grounded both in DoD relevance and in the merit competition process. We appreciate the constructive efforts of your committee and others to seek means for strengthening this relationship still further.

Chairman NUNN. Thank you, Dr. Duncan.

SECTION 220

Section 220 of the 1989 Defense Authorization Act contained provisions that, number one, required the use of competitive procedures for universities; number two, requires future legislation to take a specific action to circumvent competition. It directed the Department to submit a report by March 31 of this year on the planned implementation and projected effects resulting from that provision.

I understand we have just received that report today.

Dr. DUNCAN. No, sir.

Chairman NUNN. Which report have we received?

Dr. DUNCAN. Mr. Chairman, an amendment to the Fiscal Year 1989 Appropriations Act also required that we submit a report by February 1 in connection with identifying projects earmarked in the act that met three criteria: the DOD had not requested the money; a single academic institution was identified; and the academic institution was identified; by name.

Chairman NUNN. And that is the one you submitted today.

Dr. DUNCAN. Yes, sir, rather than the one related to section 220.

Chairman NUNN. On the first report, the one we have not received, I understand a draft is now in the process or has gone a pretty long way. What is holding that up and when do you expect us to receive it?

Dr. DUNCAN. First I would like to apologize for it being late.

As you are aware, there are some very complex issues raised by section 220, and we have experienced considerable difficulty in sorting them out. I believe, however, that we have made good progress and, indeed, our report is currently undergoing its final review in the Office of Management and Budget. I hope that it will reach you next week.

Chairman NUNN. Could you tell us generally what the thrust of that report is now?

Dr. DUNCAN. The thrust of that report is basically to support the activities of this committee that would not permit the setasides and yet, at the same time, would contain language that bears upon some 8 or 10 university laboratories that I referred to like the Lincoln laboratory and the applied physics laboratories at some universities around the country.

Chairman NUNN. Now, you make sole-source awards within the Department of Defense where Congress has had no earmarking whatsoever, do you not, on these type contracts?

Dr. DUNCAN. We make some sole-source awards in the Department of Defense for some contracts, yes. However, virtually all grants and contracts supporting university basic research activities are awarded on a competitive basis through broad area announcements.

Chairman NUNN. Even when it ends up being sole source, you have gone through some kind of competition you are saying? If it is, it's not a sole-source contract.

Dr. DUNCAN. We use competition in awarding all of our university basic research grants and contracts.

Chairman NUNN. Aren't there instances where one university has been doing a certain kind of research for a long number of years and you continue that each time the renewal comes up on a sole-source basis?

Dr. DUNCAN. It is true that we have multi-year activities, and there is continuation of research. And then we have the 8 or 10 laboratories that I referred to that are university affiliated laboratories that are affected by section 220.

Chairman NUNN. Well, I have been told that section 220 will prevent a repeat of certain contracts that have been awarded to a university that has certain unique capabilities developed over the years because it bars that. It will require those to go back out to competition. Are you familiar with that? Has the Department of Defense taken a position on those in this report? Are you asking for an exception or any kind of change in the law?

Dr. DUNCAN. To the best of my knowledge, we are not asking for a change in the law in that regard except insofar as it relates to these university affiliated laboratories that were affected by section 220.

NATIONAL DEFENSE STOCKPILE TRANSITION FUND

Chairman NUNN. How many research or construction projects have been initiated with funds specifically earmarked from the National Defense Stockpile Transaction Fund?

Dr. DUNCAN. The stockpile transaction fund, sir?

Chairman NUNN. Yes.

Dr. DUNCAN. The stockpile transaction fund does not come under my purview. It falls under the Office of the Assistant Secretary for Production and Logistics; it is not part of the R&D activities within the Pentagon.

Chairman NUNN. Is there anybody here that can speak to that? Or is that part of the report that you have submitted?

Dr. DUNCAN. The report that we submitted was only on the RDT&E earmarks. In the National Defense Stockpile Transaction Fund, I am told there were five setasides totalling $30 million in that particular bill.

Chairman NUNN. In which bill?

Dr. DUNCAN. This is in the National Defense Stockpile Transaction Funds.

Chairman NUNN. But which year did that?

Dr. DUNCAN. It's 1989.

Chairman NUNN. Is that part of the report, or do you just have that there?

Dr. DUNCAN. I have that with me. That is not part of the report.

Chairman NUNN. Would you submit for the record the list of those specifically earmarked projects in the last several years in that stockpile transaction fund?

Dr. DUNCAN. Yes, sir, I will submit that for the record.

[The information follows:]

NATIONAL DEFENSE STOCKPILE TRANSACTION FUND

Between fiscal years 1986 and 1989, Congress used the National Defense Stockpile Transaction Fund as a vehicle through which to appropriate funds for 15 projects intended for 10 recipients. These earmarks are:

FISCAL YEAR 1986

University of Nevada—Reno: Construction of a Strategic Material Engineering Center—$10 million.[1]

University of Massachusetts—Amherst: Construction of a Strategic Material Engineering Center—$10 million.[1]

FISCAL YEAR 1987

University of Nevada—Reno: Design and Renovation of the Mackay School of Mines Building—$5 million.

University of Massachusetts—Amherst: Construction of a Strategic Material Engineering Center—$5 million.

FISCAL YEAR 1988

University of Massachusetts—Amherst: Construction of a Strategic Material Engineering Center—$5 million.

University of New Mexico: Purchase of Technical Equipment for Research Project on Structural Ceramics—$1 million.

University of Utah: Construction of Biomedial Polymer Research Building—$4 million.

University of Hawaii: Construction of Strategic Materials Research Facility—$5 million.

University of Arizona: Facility Renovation and Purchase of Technical Equipment for Copper Recovery and Utilization—$4 million.

FISCAL YEAR 1989

South Carolina Research Authority: Plasma Arc Technology—$3.5 million.

University of Texas—El Paso: Transfer of Strategic Materials Technology to Industry—$3 million.

University of Hawaii: Construction of Strategic Materials Research Facility—$14 million.

Loyola College of Maryland: Construction and Equipping of Center for Advanced Information and Resource Management—$3 million.

University of Idaho: Construction and Equipping of a Strategic Research and Environmental Laboratory—$3 million.

University of Utah: Construction of Biomedical Polymer Research Building—$7 million.

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[1] After Sequestration pursuant to Public Law 99-177, the amount available for each of these schools was $9,510,000.

Chairman NUNN. Is there anyone here from the Department that can speak to that policy-wise?

[No response.]

Chairman NUNN. Does the Department of Defense have a position on whether this is an appropriate use of the funds from the stockpile transaction fund?

Dr. DUNCAN. I can't speak to the Department of Defense policy on the stockpile.

Chairman NUNN. Would you submit that and get the Secretary to give it for the record?

Dr. DUNCAN. Yes, sir.

[See questions for the record.]

Chairman NUNN. As currently enacted, would section 220 of the fiscal year 1989 act preclude the Secretary of Defense in the future from awarding earmarked contracts from the defense stockpile fund without competition? Can you speak to that, or do you want to submit that for the record?

Dr. DUNCAN. I will have to submit that for the record, too.

[See questions for the record.]

Chairman NUNN. And also whether the Department believes that there should be competition for those types of grants and contracts from the stockpile fund.

Dr. DUNCAN. I will have to submit that for the record, sir.

[See questions for the record.]

CONSTRUCTION FOR STRATEGIC STUDIES

Chairman NUNN. Dr. Duncan, are you aware of the efforts of a local university to seek $20 million in DOD funds to finance part of the construction for strategic studies on its campus?

Dr. DUNCAN. Of a local university?

Chairman NUNN. Yes.

Dr. DUNCAN. Yes, I am aware.

Chairman NUNN. Is that something that DOD is in favor of?

Dr. DUNCAN. You are talking about the one for the National Guard?

Chairman NUNN. Yes.

Dr. DUNCAN. I have seen a copy of a letter from the head of the National Guard that says there is no requirement for that. I do not know whether you have that letter or not, Mr. Chairman, but I can make that available to you.

Chairman NUNN. Does the Department of Defense have a position on that because we are going to be voting on it here in committee I assume and on the floor?

Dr. DUNCAN. The Department of Defense has no requirement for that facility.

Chairman NUNN. So, the Department of Defense would oppose that then.

Dr. DUNCAN. Yes.

Chairman NUNN. My time has expired. I will have other questions.

I believe Senator Bingaman is next and then Senator Exon.

Senator BINGAMAN. Thank you, Mr. Chairman.

SECTION 220

Dr. Duncan, let me go back to this section 220 and see if I understand things now.

My understanding of section 220 is that it essentially closes off or contemplates closing off one of the exceptions—at least one, but probably several exceptions—in the Competition in Contracting Act. And one of those exceptions is the one referred to as the essential research capability exception. Is that your understanding also?

Dr. DUNCAN. Yes, that is my understanding.

Senator BINGAMAN. Do you agree with the idea that there is a major difference between grants to universities—the awarding of grants by DOD or any Federal agency—and entering into contracts with universities to accomplish research? Would you agree that that is a valid distinction?

Dr. DUNCAN. Yes, but may I amplify on that, Senator?

Senator BINGAMAN. Certainly.

Dr. DUNCAN. In connection with these university affiliated laboratories, we are principally supporting development versus basic research. I want to draw the line between developing systems that have some hardware activity associated with them versus the type of research that we are supporting through our 6.1 programs.

I have a personal example in that regard. The Applied Physics Laboratory at Johns Hopkins University came into the Navy many years ago, when I was a naval officer, to develop the transit satellite navigation system. This was right after Sputnik, as a matter of fact, and was perceived as a new way in which space could influence the military. This was a hardware program, and it involved what I would call development versus research. This is the distinction I wanted to make.

Senator BINGAMAN. I guess what I am trying to determine is your opinion as to the value of continuing to have the ability in DOD to award contracts under this essential research capability exception where the Government determines that it has had an ongoing relationship with the university. The university has been doing research in a particular area. The Government is satisfied with that and would like to continue that effort. If we were to eliminate that exception in the law, then you would have to put that out to open bid, and that university would then have to compete with any private sector firm that wanted to come in and bid for that work.

Dr. DUNCAN. Yes.

Senator BINGAMAN. And that would in most cases I would think probably interrupt the research activity of the university.

Dr. DUNCAN. Yes.

Chairman NUNN. And I just wondered. Do you have an opinion? Does DOD have an opinion as to the appropriateness of maintaining that exception so that DOD can contract with universities to do that kind of research?

Dr. DUNCAN. The DOD wants to continue doing research with the university affiliated laboratories. There is competition there, but it is a competition of a different nature. They compete for broad programs, for systems development projects and for mission areas, and they do it through procedures which are quite different in practice from the procedures which are followed in the competition for basic and applied research single investigator projects and block programs for university academic departments. These laboratories are not part of university academic departments. They are very similar to Los Alamos and Livermore.

Senator BINGAMAN. I haven't seen the list of eight that you had in mind. Maybe you could read those off.

Dr. DUNCAN. Yes, sir. I have the list right in front of me. The Applied Physics Laboratory at Johns Hopkins University; the Applied Research Laboratory at Pennsylvania State University; Applied Research Laboratories at the University of Texas; Applied Physics Laboratory at the University of Washington; Georgia Tech Research Institute at Georgia Institute of Technology; the Physical Sciences Laboratory at New Mexico State University; the Marine Physics Laboratory, Scripps Institute of Oceanography; the Laboratory for Physical Sciences at the University of Maryland; the Systems Research Center at the Virginia Polytechnic Institute, and the Lincoln laboratories at M.I.T. These are all not-for-profits.

Senator BINGAMAN. Now, is that a comprehensive list?

Dr. DUNCAN. Yes.

Senator BINGAMAN. That's 10 you listed.

Dr. DUNCAN. I missed one. The Software Engineering Institute, a relatively recent addition compared to these others, at Carnegie Mellon.

Senator BINGAMAN. But with regard to those contracts that DOD presently has, it would be your opinion and your position that we should maintain the exception in CICA that allows you folks to go ahead and enter into those contracts on the theory that there is this essential research capability at those institutions, that it is worthwhile maintaining and using for Government purposes. Is that a fair statement?

Dr. DUNCAN. Yes, sir, except I would expand that to research and development capability.

Senator BINGAMAN. Research and development capability. But the exception is usually called essential research, but it should be essential research and development capability exception.

Dr. DUNCAN. Yes, sir.

Senator BINGAMAN. That helps clarify.

Chairman NUNN. Senator Bingaman, would you yield?

Senator BINGAMAN. Yes.

Chairman NUNN. Are you saying that the existing law provides that you can continue these practices with these? Are you saying we need to amend the law in section 220?

Dr. DUNCAN. Am I saying that, sir?

Chairman NUNN. Yes.

Dr. DUNCAN. In section 220, as we propose it, it would permit us to continue work with these university affiliated laboratories in the way that we are now working with them.

Chairman NUNN. Well, is that something we have to do in the law? Are you saying that we need to change the current law, and are you requesting that we change the current law?

Dr. DUNCAN. We are requesting that you change the current law.

Chairman NUNN. Do you have a specific legislative proposal?

Dr. DUNCAN. We have, but it is not an executive branch proposal because it hasn't been released yet by the Office of Management and Budget.

Chairman NUNN. Will that be part of this report that we are going to be getting, or is that separate?

Dr. DUNCAN. That will be part of the report you will be getting, which is long overdue unfortunately.

Chairman NUNN. Thank you, Senator Bingaman.

Senator BINGAMAN. There is some draft language that I have been given, Mr. Chairman, which I will just hand you for your review.

I do not know. Has my time run out?

Chairman NUNN. No.

Senator BINGAMAN. Well, let me just ask one question on a different subject.

AWARD OF RESEARCH FUNDS

You say over here on page 12 of your testimony, talking about the various decisions to make awards of research funds, that proposals are evaluated and selected for funding based on a number of criteria, the two principal ones being the scientific or technical merit of the research proposed and the potential relationship to the DOD mission.

"OLD-BOY PROCESS"

Each year that the subject of setasides or earmarkings has come up here in the Senate, those of us who have weighed in against the legislature, against the Congress in specifying where research funds should go, each time we make that argument, we run into the counter-argument that the selection process by which you purportedly determine merit is rigged. That is basically the argument that is made by a lot of people representing smaller schools. And they say, look, you have an old-boy network going here where all these big schools that have traditionally done very well under these programs get their people on the boards and they scratch each others back. And accordingly, those of us who are not part of the old-boy network—it doesn't matter how good a proposal we have. It doesn't matter how good quality the research might be that we could accomplish. We are not going to get these awards and therefore our only avenue of redress is through the Congress.

How do you respond to that?

Dr. DUNCAN. You have articulated a very difficult and very significant problem, and one about which I feel quite strongly.

I personally word this problem as the "haves" continue to be the "haves," and the "have-nots," continue to be the "have-nots." That is the problem that you have described.

I think the correct direction toward resolving this is the initiative that this committee has taken in recent years, to strengthen the infrastructure nationwide and broaden the participation of institutions that we have not historically funded. We are building our new Research Initiation Program incrementally, starting out with $5 million this year, $10 million next year, working up to a certain percentage level.

I think what has been enlightening to us is how good the proposals have been from institutions, such as the Historically Black Colleges and Universities, and others that have not been major recipients of DOD funding in the past. We have made selections we consider to be very good selections.

Now, with respect to the old-boy network, or bias in the selection process, the selection process in every case that I have examined is fair and open and does not involve prejudice or bias. But, it is true that if a university has a strong academic department, research instruments, Nobel laureates and comparable assets, that institution will be at an advantage in comparison to others. We have to help more institutions to develop research capabilities, but earmarking money to build a library or other facility is not resolving that problem.

This committee has the right approach, and I applaud this committee and hope that you will continue that.

Senator BINGAMAN. My time is up, Mr. Chairman.

Chairman NUNN. Thank you.

Senator Gorton.

Senator GORTON. No questions, Mr. Chairman.

Chairman NUNN. Senator Exon.

Senator EXON. Mr. Chairman, thank you very much.

REBUILDING OUR SCIENTIFIC AND TECHNICAL RESEARCH INFRASTRUCTURE

Two or three questions, Dr. Duncan. Throughout your testimony, I note that you have commented upon the need to rebuild our scientific and, of course, our technical research infrastructure. Would you comment on how well we have done that or not done that in the last 8 years? How are we doing?

Dr. DUNCAN. I think we are making progress, but more progress has been made in the last couple of years as we specify certain percentages of our URI money in this new Defense Research Initiation Program. Also, the last competition of the DURIP program, the instrumentation program, specified a certain percentage or dollar amount that would go to those universities that historically had not received awards from the Defense Department. So, we are making progress. I think the most progress has been in the last couple of years. And I would hope that that will gain momentum.

And I must say, as I said to Senator Bingaman, this committee has taken the leadership role in that regard and I applaud that.

Senator EXON. Well, thank you. We have been very much concerned about this for some time. And evidently the last 2 years then, if I understand what you are saying, is a significant start. Now, we have to keep the momentum going. Is that essentially what you are saying?

Dr. DUNCAN. Yes, sir. That's what I'm saying.

LACK OF PH.D.'S IN DEFENSE RELATED AREAS

Senator EXON. Your remarks also echo the conclusions that we have heard from other educational groups and people interested in this whole broad field of scientific and technical areas. And we have been warned previously about the lack of American citizens being given the opportunity to obtain a Ph.D. in this particular area.

Does this drying up of our reservoir of Ph.D.s held by American citizens appear to be a problem for our defense related research which is the main thrust of this committee's activities in the past?

Dr. **DUNCAN**. Well, I think we have more of a problem in engineering than we do in the sciences. The gentlemen that will follow me in the next panel probably have specific figures, but it is my understanding that somewhere between 55 and 60 percent of the engineering Ph.D. candidates now in the universities around this country are foreign.

And engineering is the area in which we put things into practice. Engineering is synonymous in my mind, or almost synonymous, with technology. Where we have lost the leadership role in this country to others is in the field of technology, translating things from the laboratory into useful end items. It is of concern.

Senator **EXON**. Is there an effort to leverage our research dollars so that we can be assured that it supports a significant number of students who intend to pursue advanced research in all of these fields that we think is important if we want to encourage the bright people to get into the national defense field?

Dr. **DUNCAN**. Well, we are now supporting 8,000 students all together. Most of these are research assistants. I think 520 of them are fellowship recipients.

As we increase our programs—and I hope we increase our programs—that number will also increase. We will focus on disciplines that are of interest to defense, and by and large defense supports the physical sciences.

I think it is very important that as this committee and other committees talk about broadening the base, whether it be geographically or whether it be by disciplines, that you look at the total Federal activities. The National Institute of Health, for example, is the primary funder in the field of medicine and in dentistry. Defense has very little in that area. But it is very important that we have the right balance.

Senator **EXON**. My question was do you think that we have leveraged what dollars we have had available sufficiently enough or have we just dished it out on the basis of creating Ph.D.s in areas that might not be directly connected with defense? That is the specific question. Do you think we could do a better job of leveraging? When I get into the field, I know immediately in the land of academia—oh, don't be telling us what to do. You give us the money and we'll produce what we want to produce.

The idea of this money is to try and encourage some of the brighter people to get into this field of national defense that many of us think is very important.

Could we leverage the money better or do you think we should not?

Dr. **DUNCAN**. I think we leverage it very well. We probably could leverage it better, but I think we leverage it well.

Now, some people are critical of fellowship programs as compared to research assistant programs. Let me comment on why they are critical, and also why I think it may not be a valid criticism.

A research assistant works with a professor on a specific project, and that project, if that professor gets money from the DOD, has some defense relevance because he proposed it in response to a Broad Area Announcement [BAA]. He has won the award through competition, and has demonstrated its military relevance. The people who support research assistants say this is the best way to leverage this money because the students are working directly on activities related to DOD needs.

Fellowships, on the other hand, pay a student's living expenses and tuition, and the student can work out his own arrangement as to what institution he goes to and his own arrangements for his thesis research. He has much more freedom, and that may mean that he could be doing research that has nothing to do with defense.

However, there is such goodwill built by the fellowship program toward defense that I believe we should have a certain percentage of fellowships. That goodwill more than balances the lack of directed research that may be associated with fellowships.

Senator EXON. Thank you, Dr. Duncan. My time is up. Thank you, Mr. Chairman.

Chairman NUNN. Senator Gorton.

Senator GORTON. No questions.

BROADENING INFRASTRUCTURE

Chairman NUNN. Dr. Duncan, you set your own goal internally based on the committee directive to broaden the infrastructure, but you set the percentage goal within the Department of Defense. Is that right?

Dr. DUNCAN. Yes, sir.

Chairman NUNN. And that percentage goal is what? Five percent the first year, 10 percent the second, and 15 percent the third? Is that correct?

Dr. DUNCAN. We have broadened the goals for two of our programs—our instrumentation effort in fiscal year 1988 and our new Research Initiation Program which we began in fiscal year 1989. We set 15 percent of the instrumentation programs to be awarded on the basis of broadening the infrastructure. The actual amount we awarded was closer to 20 percent because the proposals were that good.

For the new Research Initiation Program, which is part of URI, we did it on the basis of a dollar level of $5 million in fiscal year 1989, the first year; $10 million will be awarded in fiscal year 1990. We are going to increase this to 15 percent of the total URI by 1991. I believe, Mr. Chairman, that you have to build these programs gradually.

Chairman NUNN. That is not a ceiling, though.

Dr. DUNCAN. That's not a ceiling. As I indicated, we exceeded our goal in one instance, our instrumentation program, because of the quality of the proposals we received.

Chairman NUNN. So, it could conceivably go higher.

Dr. DUNCAN. Yes, sir.

Chairman NUNN. At some point do you visualize that these schools that have become part of a broadened infrastructure will no longer need a setaside, but will just compete for the entire 100 percent pool of the money? Is that the goal, or what is the goal?

Dr. **DUNCAN**. Well, I may have misunderstood your question, but they don't have setasides.

Chairman **NUNN**. Well, I use the term "setaside" by the way you are describing this 15 percent. I'm not talking about earmarking a designated person.

Dr. **DUNCAN**. I see.

What we are doing is specifically encouraging institutions that we haven't been historically working with to apply and compete for these funds.

Chairman **NUNN**. You are taking a certain part and you are saying let's use this for broadening.

Dr. **DUNCAN**. Let's use this for broadening.

RESEARCH INITIATION PROGRAM

Chairman **NUNN**. What do you want to call that fund? Do you want to call it a special fund for broadening?

Dr. **DUNCAN**. We call it the Research Initiation Program, which is a part of the University Research Initiative.

Chairman **NUNN**. Once you have gone through a few years of that and you have, indeed, broadened your base, would it not be your long-term goal for all of these people to participate in the entire 100 percent?

Dr. **DUNCAN**. Yes, sir. That is our intention in the long run.

Chairman **NUNN**. Senator Bingaman.

NATIONAL DEFENSE SCIENCE AND ENGINEERING GRADUATE FELLOWSHIP PROGRAM

Senator **BINGAMAN**. I would just ask one other question, Mr. Chairman. Dr. Duncan, you have a statement in here about this National Defense Science and Engineering Graduate Fellowship Program. Senator Nunn and Senator Hatfield sponsored a certain amount of money in the appropriations process, I guess $10 million, last year for that. But my information is that DOD has not treated that as an ongoing program. It is treated as a one-shot arrangement and, therefore, you have identified 120 graduate students to receive 3-year fellowships.

I guess what I would like to do, first, is get any information from you as to how that program works. I have had trouble getting that information. My staff has had trouble getting that information. And then just alert you that we are planning to try to authorize that in this year's bill and put additional funds into it, and hope that that can become an ongoing program growing in importance.

Do you have any comments on that program at this point or how you are administering it?

Dr. **DUNCAN**. Because we could not be sure of continuation funding for this program, we used the $10 million to forward fund the program for all 3 years. It is a 3-year fellowship program, and we selected 120 students for the whole period so that the students would be assured of support for the entire period. It does mean, then that in following years we can bring in new students and continue with that process.

Now, even though we do not have a formalized program this year in that regard, we are investigating the process of trying to formalize one. It does mean we must divert funds from other 6.1 work.

Senator **Bingaman**. I would just urge that if you have thoughts about how that program should be formalized, we would like to hear them in the next few days because we are getting ready to authorize it.

Dr. **Duncan**. I will see that we get such information to you. I personally feel that it has been done very well and am supportive of the program.

[The information follows:]

National Defense Science and Engineering Graduate Fellowships

My office worked with the research offices of the services to launch this new program in fiscal year 1989. We designed into it the best features of our highly successful, ongoing fellowship programs. We also met with officials of the National Science Foundation and incorporated their good ideas.

We awarded 122 fellowships in the new program this year, with about half of the fellowships in engineering fields and half in the sciences. About 15 percent of the fellowships were awarded to minorities underrepresented in science and engineering. This exceeded our stated goal to award 10 percent of the fellowships to minorities. We also awarded about 25 percent of the fellowships to women.

We see merit to continuing the increased level of fellowship effort in fiscal year 1990 and we have been working with the services to identify funds for this purpose. With regard to your authorization of the program, we would prefer that program details not be specified in statute or report language. This would allow us to blend the new program as fully as possible with our existing programs and to create simpler application procedures for students seeking DOD fellowship support.

Senator **Bingaman**. Well, I am too, and I just want to see that what we do makes sense from the point of view of folks in your Department.

Chairman **Nunn**. Dr. Duncan, that information on the stockpile. We would like to get your own assessment of that, what has happened, and what you believe ought to happen, and a DOD position on the earmarking or setting aside—whatever term you want to use—on the stockpile.

Dr. **Duncan**. We will get it over to you as early as we can.

Chairman **Nunn**. I understand the information is already available, and we had understood it might be available today—within the Department of Defense.

Dr. **Duncan**. All I have is a list of the specific $30 million this year that was involved.

Chairman **Nunn**. Thank you very much, Dr. Duncan.

Dr. **Duncan**. Thank you.

Chairman **Nunn**. We appreciate your being here.

I have already introduced our next panel, but let me just recap briefly. We have two distinguished witnesses from the scientific and academic community. Dr. Frank Press is President of the National Academy of Sciences and formerly served as science adviser to the President, and Mr. Joe Wyatt is the Chancellor of Vanderbilt University and, of course, also will be addressing these issues on behalf of the American Association of Universities. Dr. Press and Chancellor Wyatt, we are delighted to have both of you here today.

Dr. Press, if you have an opening statement, we will be glad to have it followed by Mr. Wyatt, and then we will have questions for both of you.

STATEMENT OF DR. FRANK PRESS, PRESIDENT, NATIONAL ACADEMY OF SCIENCES

Dr. **Press**. Mr. Chairman, I have a statement for the record, and I would like to abbreviate it for oral testimony. It will take less than 10 minutes or so.

Chairman **Nunn**. Without objection, it will be made part of the record.

Dr. **Press**. Mr. Chairman, to begin with, I do not detect any serious doubt in the defense community or Congress that fundamental research enhances the Nation's defense capabilities, for example, in providing qualitatively superior weapon systems that offset the numerical superiority of opposing forces. By the same token, there is general agreement that DOD has a vital stake in helping to maintain a strong science and engineering base.

Mr. Chairman, with your leadership and encouragement, the Department of Defense has in the last decade undertaken a number of constructive efforts to shore up the science and technology base. The DOD instrumentation program helped to reduce the backlog of university equipment needs and permitted university laboratories engaged in R&D useful to DOD to obtain state-of-the-art equipment. The University Research Initiative enabled a number of institutions to undertake multidisciplinary R&D programs relevant to DOD interests. And just this past year, you and Senator Hatfield recognized the shortfall of U.S. citizens obtaining advanced degrees in science and engineering and directed the Department of Defense to establish a new graduate fellowship program.

I applaud these initiatives and I urge the committee to continue to make sure that the Department supports them or programs like them. But I do have one concern. All of these efforts have been launched within a level budget in real terms. During the defense buildup of the last 10 years, expenditures on fundamental and exploratory research activities—that is, the 6.1 and the 6.2 DOD budget categories—have not grown, let alone at the rate of the DOD budget as a whole or even the RDT&E share of the defense budget.

There is one important component of the science and technology infrastructure that is not represented in the Department's portfolio of programs. I refer to the financing of university research facilities. From all of the assessments I have seen, the need to renew the physical plant for academic science and engineering is pressing. In its recent survey, the National Science Foundation found that about 40 percent of current research space is in need of repair or renovation. But the need is not merely a result of deferred construction and delayed modernization. It is also a function of the requirements for exploiting new opportunities in research. Added to these demands are the perceptions of elected officials that science and engineering programs contribute to local and regional economic development and thus are desirable assets in the short term.

In the absence of any significant program of Federal support, these pressures are being manifested and partially relieved in an ad hoc, disorganized manner. In particular, we have seen in recent years a growth industry in congressional appropriations for buildings at individual institutions, the so-called earmarking process. As you heard before, in the last Congress an estimated $300 million was earmarked for specific projects at colleges and universities. As much as one-half of that amount was for academic science and engineering facilities. In most cases such earmarks circumvent merit review procedures. In a few cases, they are attempts to overturn negative decisions in an open competition.

I do not question the motivations of those who seek and support these earmarks nor the prerogatives of Congress to appropriate funds as the majority sees fit. It was Senator Russell Long who a few years ago reminded us, "when did we agree that the peers," which he pronounced pears, "would cut the melon or decide who gets this money?" He said, "I have been around here for a while. I do not recall that I ever agreed to that." Whether he agreed to it or not, no one doubts the authority of Congress to preempt peer review.

Nevertheless, in an area as strategic as science and technology, there are sound reasons why a number of professional organizations, including the National Academy of Sciences, have questioned the wisdom of dispensing funds in this way and why, commendably, this committee has taken steps to curb the practice.

The principal objections to targeted congressional appropriations are these.

Objective judgment of the scientific and technical merit of research proposals in open competition has contributed to the scientific preeminence of the United States and the fulfillment of Federal agency missions. Such review is as important to the awarding of funds for facilities as it is to the support of scientific research projects.

Without such review, there are serious concerns about whether we are allocating scarce Federal resources to meet the most pressing needs and opportunities in science and engineering or, on the other hand, to serve some secondary objectives of parochial interests.

Influence in the process is highly concentrated. The lobbying resources of institutions and the seniority and committee assignments of Members of Congress weigh more heavily in these appropriations than the nature and quality of the proposed project.

Often these actions are cloaked in secrecy until the deed is done at the 11th hour of a conference committee so that even among Members of Congress, peer review is a misnomer.

The best alternative to the growing practice of targeted congressional appropriations is a comprehensive approach to facility financing, one that uses several mechanisms to attack the facilities deficit and involves contributions from Federal and State governments, universities and the private sector. Congress must play a central role, setting appropriate levels of funding, establishing general criteria to guide the award of grant funds, specifying review procedures, and through oversight, ensuring that the agencies are responsive to congressional guidance. But judgments about which particular investments are most likely to serve agency missions and the long-term vitality of the science and engineering base should be the responsibility of government policymakers with appropriate authority, expertise and experience, assisted by appropriate advisory mechanism.

The comprehensive facilities program that I have recommended would include the following elements. First. Participation by all Federal agencies with significant science and engineering programs, NIH, Energy, NASA, USDA and Defense, as well as the National Science Foundation. This does not mean duplication of effort nor the creation of a cumbersome interagency administrative apparatus. Relevance to an agency's mission should continue to be a prime criterion of support.

Second. By implication, there should be several program models with different criteria that recognize different objectives—the maintenance and renewal of facilities at existing centers of strength; the creation of additional centers of strength in areas of science and engineering of particular importance to DOD and the other agencies; and the expansion of the number and types of institutions with capacity to carry out R&D and training of interest to DOD and the other agencies.

Third. Subject to controls to prevent bidding wars, there should be a significant amount of local cost sharing for buildings with the Federal Government. And this cost sharing could derive from institutional funds, State appropriations and private donations.

Fourth. The use charge in Federal research grants should be increased to reflect real costs. This change by itself could have a significant impact on the ability of universities to maintain and renew current research facilities.

Fifth. The limits of debt financing by private educational and research institutions should be removed.

Sixth. We should set a 5-year goal of removing a major part of the facilities deficit caused by two decades of neglect. Budget deficit reduction is a national imperative. As these deficits are reduced, however, we should be thinking of a program on the order of $1 billion per year across all of the agencies for both refurbishing and new construction of laboratories and buildings.

Finally a few observations about mandatory formulas and ceilings to ensure a broad geographic distribution of Federal funds for research and training, as well as facilities. Many are skeptical of the ability of the merit review process to assess the scientific and technical potential of less well known researchers at less well established institutions that are seeking to develop their research capacities. Although there are no guarantees, it is nevertheless the case that during the 1960s Federal agencies administered successful competitive grant programs that moved a number of second tier universities in various parts of the country into the front ranks of research institutions.

Capacity building in my view must begin with local initiative and investment that come from institutional resources, state appropriations or private donations. Once an evaluation shows that there is a potential for quality programs to emerge, Federal assistance is appropriate to nurture development in directions consistent with agency missions and national goals.

Second, care should be exercised in interpreting data that are purported to show a disproportionate allocation of research funds to a few States. The allocation of Federal R&D dollars is primarily a function of the distribution of scientists and engineers in the country. It also depends on the mission of the agency, the field of inquiry, and other factors. The geographical distribution of DOD R&D expenditures is very different from that of NSF, NIH, DOE and the other agencies, and that is appropriate and to be expected. Similarly, the geographic distribution of funds in oceanography, for example, is concentrated at coastal institutions, and that is different from that in chemistry or electrical engineering.

Third, the desire to create new capacity must be balanced with the need to maintain and renew existing capacity. Past national investments have created an extensive research infrastructure, much of which is in need of repair, renovation and replacement. It does not make sense to allow the centers of excellence that have done the most productive work to deteriorate. Neither does it make any sense to ignore aspiring institutions.

The United States did not achieve a world leadership position in science and technology by the haphazard and somewhat cynical use of earmarking funds for particular institutions and programs nor by the application of rigid rules to spread the wealth as evenly as possible. Neither can the United States hold its position by circumventing tested and proved processes of competition and awards based on scientific and technical merit. I frankly do not think it is necessary to choose between superior science and technology for agency missions and national goals on the one hand, and local interests and educational opportunity and economic development on the other hand. The approach I have outlined is one way to achieve a balance.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Press follows:]

STATEMENT OF

FRANK PRESS, PRESIDENT

NATIONAL ACADEMY OF SCIENCES

Mr. Chairman and Members of the Committee, I am pleased to participate in this hearing to examine the Defense Department's support of university science and engineering. As you requested, my remarks this afternoon will focus on the procedures and criteria for allocating funds among institutions — especially the issues of earmarking money for research facilities and geographical distribution of research awards. But first let us be clear about the purposes of DOD's support of academic research and the broad consensus supporting those purposes.

Last winter, the National Academies of Sciences and Engineering and the Institute of Medicine issued a report, Federal Science and Technology Budget Priorities, in response to a congressional request. Some of you are familiar with the framework we outlined in that report for analyzing federal science and technology budget proposals. The framework includes four overlapping categories, of which two are relevant to the Defense Department's investment in academic research and development. First, such programs are intended to support, and should be evaluated in terms of their potential contribution to, DOD's military missions. Second, they also contribute to the science and engineering infrastructure that serves all sectors, including the military. By "infrastructure" I mean the generation of new knowledge, the education and training of people to perform R&D as well as to produce and implement sophisticated technologies, and the availability of essential research and test equipment and facilities.

There may be disagreement about the role of particular programs and projects and about the proper mix of activities. But I don't detect any serious doubt in the defense community or Congress that fundamental and exploratory research enhances the nation's defense capabilities, for example, in providing qualitatively superior weapon systems that offset the numerical superiority of opposing forces. By the same token there is general agreement that DOD has a vital stake in helping to maintain a strong science and engineering base. Leaders of the defense establishment are right to be concerned about apparent weaknesses in that infrastructure, whether in the supply of physical scientists and engineers or in the development of advanced technologies.

Mr. Chairman, with your leadership and encouragement, the Defense Department has in the last decade undertaken a number of constructive efforts to shore up the science and technology base. The DOD instrumentation program helped to reduce the backlog of university equipment needs and permitted university laboratories engaged in R&D useful to DOD to obtain state-of-the-art equipment. The University Research Initiative (URI) enabled a number of institutions to undertake multidisciplinary R&D programs relevant to DOD interests. And just this past year, you and Senator Hatfield, recognizing the shortfall of U.S. citizens obtaining advanced degrees in science and engineering, directed the Department to establish a new graduate fellowship program.

I applaud these initiatives, and I urge the Committee to continue to make sure that the Department supports them or programs like them. But I do have one concern. All of these efforts have been launched within a level budget in real terms. During the defense buildup of the last ten years, expenditures on fundamental and exploratory research activities -- the 6.1 and 6.2 DOD budget categories -- have not grown, let alone at the rate of the DOD budget as a whole or even the RDT&E share of the defense budget. Additional resources are required to support these special needs of the science and technology infrastructure along with the ongoing science and technology base programs.

There is one important component of the S&T infrastructure that is not represented in the Department's portfolio of programs. I refer to the financing of university research facilities. From all of the assessments I have seen, the need to renew the physical plant for academic science and engineering is pressing. In its recent survey, "Scientific and Engineering Research Facilities at Universities and Colleges, 1988," the National Science Foundation found that about forty percent of current research space is in need of repair or renovation. But the need is not merely a result of deferred construction and delayed modernization. It is also a function of the requirements for exploiting new opportunities in research — for example, the need for dust- and vibration-free clean rooms to conduct state-of-the-art microelectronics work. Unmet space needs make it difficult to compete with industry for first-rate researchers, limit the variety of projects that can be undertaken, and inhibit interaction among colleagues and students because of lack of contiguous space. These needs generate intense pressures on the part of scientists, engineers, and university administrators to obtain new facilities money from whatever source. Added to these demands are the perceptions of elected officials that science and engineering programs contribute to local and regional economic development and thus are desirable assets in the short term.

In the absence of any significant program of federal support, these pressures are being manifested — and partially relieved — in an ad hoc, disorganized manner. In particular, we have seen in recent years a growth industry in congressional appropriations for buildings at individual institutions. In the last Congress an estimated $300 million was earmarked for specific projects at colleges and universities. As much as one-half of that amount was for academic science and engineering facilities. In most cases, such earmarks circumvent merit review procedures; in a few cases, they are attempts to overturn negative results of open competition.

I do not question the motivations of those who seek and support these earmarks nor the prerogative of Congress to appropriate funds as the majority sees fit. It was Senator Russell Long who a few years ago reminded us, "When did we agree that the peers (pronounced "pears") would cut the melon or decide who gets this money? I have been around here for a while. I do not recall that I ever agreed to that." Whether he agreed to it or not, no one doubts the authority of Congress to preempt peer review.

Nevertheless, from the standpoint both of an agency's mission and S&T infrastructure needs, there are sound reasons why a number of professional organizations, including the National Academy of Sciences, have questioned the wisdom of dispensing funds in this way and why, commendably, this Committee has taken steps to curb the practice.

The principal objections to targeted congressional appropriations are these:

- Objective judgment of the scientific and technical merit of research proposals in open competition has contributed to the scientific preeminence of the United States and the fulfillment of federal agency missions. Such review is as important to the awarding of funds for facilities as it is to the support of scientific research projects.
- Without such review, there are serious concerns about whether we are allocating scarce federal resources to meet the most pressing needs and opportunities in science and engineering or to serve some secondary objectives or parochial interests.
- Influence in the process is highly concentrated. The lobbying resources of institutions and the seniority and committee

assignments of members of Congress weigh more heavily in these appropriations than the nature and quality of the proposed project.

- Often these actions are cloaked in secrecy until the deed is done at the eleventh hour of a conference committee so that even among members of Congress "peer review" is a misnomer. This Committee has seen this phenomenon first-hand.

The best alternative to the growing practice of targeted congressional appropriations is a comprehensive approach to facility financing, one that uses several mechanisms to attack the facilities deficit and involves contributions from federal and state governments, universities, and the private sector. Congress must play a central role, setting appropriate levels of funding, establishing general criteria to guide the award of grant funds, specifying review procedures, and through oversight ensuring that agencies are responsive to congressional guidance. But judgments about which particular investments are most likely to serve agency missions and the long-term vitality of the science and engineering base should be the responsibility of government policymakers with appropriate authority, expertise, and experience, assisted by appropriate advisory mechanisms.

The comprehensive facilities program that I have recommended would include the following elements:

- Participation by all federal agencies with significant science and engineering programs — NIH, Energy, NASA, USDA, and Defense as well as the National Science Foundation. This does not mean duplication of effort nor the creation of a cumbersome interagency administrative apparatus. Relevance to an agency's mission should continue to be a prime criterion of support.

- By implication, there should be several program models with different criteria that recognize different objectives: the maintenance and renewal of facilities at existing centers of strength; the creation of additional centers of strength in areas of science and engineering of particular importance to DOD and other agencies; and the expansion of the number and type of institutions with capacity to carry out R&D and training of interest to DOD and other agencies.

- Subject to controls to prevent bidding wars, there should be a significant amount of local cost sharing for buildings with the federal government. This cost sharing could derive from institutional funds, state appropriations, and private donations.

- The use charge in federal research grants should be increased to reflect real costs. This change by itself could have a significant impact on the ability of universities to maintain and renew current research facilities.

- The limits of debt financing by private educational and research institutions should be removed.

- We should set a five-year goal of removing a major part of the facilities deficit caused by two decades of neglect. Budget deficit reduction is a national imperative. As deficits are reduced, however, we should be thinking of a program on the order of $1 billion per year, for both refurbishing and new construction of laboratories and buildings.

Finally, a few observations about mandatory formulas and ceilings to ensure a broad geographical distribution of federal funds for research and training as well as facilities. Many are skeptical of the ability of the merit review process to assess the scientific and technical potential of less well known researchers at less well established institutions that are seeking to develop their research capacities. Although there are no guarantees, it is nevertheless the case that during the 1960s, federal agencies administered successful competitive grant programs that moved a number of second-tier universities in various parts of the country into the front rank of research institutions. Capacity building, in my view, must begin with local initiative and investment that come from institutional resources, state appropriations, or private donations. Once an evaluation shows there is a potential for quality programs to emerge, federal assistance is appropriate to nurture development in directions consistent with agency missions and national goals.

Second, care should be exercised in interpreting data that are purported to show a disproportionate allocation of research funds to a few states. The allocation of federal R&D dollars is primarily a function of the distribution of scientists and engineers in the country. It also depends on the mission of the agency, the field of inquiry, and other factors. The geographical distribution of DOD R&D expenditures is very different than that of NSF, NIH, DOE, or NASA — and that is appropriate and to be expected. Similarly, the geographical distribution of funds in oceanography, concentrated at coastal institutions, differs from that in chemistry or biology.

Third, the desire to create new capacity must be balanced with the need to maintain and renew existing capacity. Past national investments have created an extensive research infrastructure, much of which is in need of repair, renovation, and replacement. It does not make much sense in terms either of an agency's needs or of the strength of the S&T base to allow the centers of excellence that have done the most productive work to deteriorate. Neither does it make any sense to ignore aspiring institutions.

The United States did not achieve a world leadership position in science and technology by the haphazard and somewhat cynical use of earmarking funds for particular institutions and programs nor by the application of rigid rules to spread the wealth as evenly as possible. Neither can the United States hold its position by circumventing the tested and proven processes of competition and awards based on scientific and technical merit. I frankly do not think it is necessary to choose between superior science and technology for agency missions and national goals on the one hand and local interests in educational opportunity and economic development on the other hand. The approach I have outlined is one way to achieve a balance.

Chairman NUNN. Thank you very much, Dr. Press. That was very helpful testimony and you gave us a series of thoughts and ideas and suggestions in this overall area. With your tremendous experience, we will take them very seriously. So, we appreciate it.

We will come back for questions, but let's go ahead and hear from Chancellor Wyatt.

STATEMENT OF JOE B. WYATT, CHANCELLOR, VANDERBILT UNIVERSITY

Mr. WYATT. Mr. Chairman, thank you very much. It's a pleasure to be with you today to discuss several interrelated issues that concern the Nation's research universities.

My testimony is presented on behalf of four leading higher education associations which together represent virtually all research universities engaged in DOD supported research programs. We have submitted complete testimony. I would like the opportunity to summarize in a brief form if that would be permitted.

Questions concerning the respective roles of Congress and of open merit-based competition in the award of Federal funds for research and research facilities are being discussed in Congress and the executive branch and across the university community with renewed urgency and for good reason. Few questions probe so fundamentally at the roots of our research and education enterprise as these. What federally supported research is to be done in the national interest? Where will it be done? Who will do it? And at what level should it be funded?

We also must ask who answers these questions; how they make their decision and to whom are they accountable?

And finally, we must ask what is the role of the expert and what is the role of the non-expert in the decisionmaking process?

In answering these questions, the need for judgment and restraint is shared by both Congress and the scientific community. Whenever the vulnerabilities of the legislative process are successfully exploited for gain by individual institutions, I believe we risk eroding the foundation of support for the effective decisionmaking processes which have made our research enterprise the largest, the most competitive and the most productive in the world.

Congress and the administration have dual responsibility for repairing an eroding investment strategy in the award of Federal funds for research and research facilities. As you, Mr. Chairman, and others in Congress have clearly pointed out, there is a point in the process at which political leaders usually and appropriately choose to refrain from involving themselves. They do so because other decisionmaking mechanisms accountable to Congress have been proven over time to produce results that better serve the broader national interest.

The use of those expert decisionmaking mechanisms has eroded, particularly in the last decade which has been characterized by tightened budgets, fewer dollars to address crumbling research infrastructure and changes in tax policy which have reduced or eliminated other funding sources for research universities.

In addition, the earmarking practice by Congress has subverted responsible competition by skirting or reversing competitive review decisions. This erosion in the competitive funding process has led to national research priorities set not by legislatures, not by government officials, not even by scientific experts, but by lobbyists.

It is our view that individual institutions and their lobbyists should not be setting national research policy. And the Nation is not well served as long as Congress allows them to do so. Such a process is inappropriate and unfair. Worse, it results in the misdirection of very scarce resources. In such an environment, universities faced with the shortage of funds and increasing demands for expensive and sophisticated instrumentation must make a choice. Our research universities are both able and prepared to compete for research dollars, but without a fair mechanism for this competition, institutions are coming to believe they must choose whether to pursue earmarked funds—a practice which we have condemned—or risk falling behind in research funding.

As the chief executive officer of Vanderbilt University I face this decision continuously. So do my colleagues at other universities. But as individuals and as an association we know that earmarking undermines our national effort to produce the highest quality research establishment. As an association we have no method for enforcing any standard on those universities who turn to earmarking. Voluntary restraint, a fragile principle under the best of circumstances, is our only enforcement discipline. But it would not be if

Congress adopted a no-earmarking stance and fully supported competitive review.

Many of us responsible for the future welfare of these institutions admit, usually to one another, to feeling a deep pessimism about our continuing ability to meet the escalating costs of modern research and education programs. The problem has been thoroughly documented by several recent studies. You have heard something about those already. Last year the National Science Foundation [NSF] reported that for every dollar universities are now spending for repair and renovation of research labs, $3.60 is being deferred. For every dollar planned for new construction, $2.50 must be deferred. About 40 percent of present laboratory space is in need of renovation and repair.

A 1988 report by several associations done by Coopers & Lybrand states that the Nation's 104 leading research universities alone face urgent needs totalling more than $7 billion.

In 1985 the Department of Defense prepared a report which concluded a shortfall of about $300 million for only a handful of universities.

The primary factors contributing to the facilities deficit are summarized in a new report to the National Science Foundation by the Association of American Universities and the National Association of State Universities and Land-Grant Colleges. A copy of the report also is appended to my statement, and we ask that it be made part of the hearing record.

Briefly summarized, in most institutions a few factors account for most of the research facilities deficit.

First, there is the accelerating pace of scientific progress and instrumentation requirements. The nature of science itself continues to change rapidly and the pace of change is accelerating. Modern scientific instruments have become increasingly expensive. We have extremely rapid rates of obsolescence, sometimes as short as 1 year, sometimes 3 years, only occasionally longer. All that raises the cost of developing facilities.

Second, the cost of providing laboratory space for faculty increases. Recruitment and retention of faculty is hampered by our inability to do so. The cost to equip a new research professor—this is a new assistant professor—often exceeds $250,000, and in some cases exceeds $1 million, depending on the kind of research that is to be done.

Third, we face continuous regulations and standards. Federal, State and local governments have imposed regulations and building standards that at once render adequate facilities obsolete and add substantial cost. While universities recognize and respect the need to meet the societal standards of waste storage and disposal, asbestos removal and handicap access, these costs are largely ignored by Federal research funding agencies, and thus they too put pressure on other sources of funds, including tuition.

And fourth, we have many old and obsolete buildings. Frequently it is neither cost-effective nor possible to renovate old, inflexible facilities. They must be replaced. Unless they are, the quality of the research and education programs housed in these laboratories is compromised.

These are the circumstances and the pressures that have led us to the current epidemic of earmarking.

But there is a better way: a strong investment strategy developed jointly by the administration and Congress and administered through competitive review by the agencies. Now is the time for Congress to provide both a comprehensive strategy and the institutional discipline of competitive review. This is not a partisan issue.

Congress can end a practice which has misdirected Government resources and has not produced and cannot produce the competitive research capability the American people deserve. When it comes to the national defense and our country's ability to compete economically, there is no excuse for a policy which puts funds in programs which cannot be competitively tested, or which establishes and then continues to fund programs of questionable validity. There is no place for a policy that allows back door earmarked funding to be allowed to replace programs which have been funded through a competitive, scientific and professional review.

I applaud the action of this committee and you, Senator Nunn, in rejecting the practice of special interest funding of research projects and call on Congress to again rely on the impartiality of scientific peer review as the method for establishing and funding our Nation's research priorities.

Turning briefly to section 220, if I may, we commend you and the members of the committee for your leadership in seeking a means to ensure that competitive procedures are followed when grants or contracts are awarded to colleges and universities. We understand the objective of the provision and we applaud the intention to curb the practice of earmarking using the funds of the Department of Defense.

We are concerned, however, that the effects of section 220 may be damaging to some research universities, including some which entered into unique arrangements with the Department more than 40 years ago as part of the World War II effort. Even now it is necessary in some types of research and development projects for the Department to establish long-term relationships.

When Congress enacted the Competition in Contracting Act, it recognized the need to provide the Department to enter into special arrangements for exceptional circumstances. It is our understanding that the exceptions have served their intended purpose. We know of no evidence that they have been employed inappropriately, although we recognize the potential for abuse.

We also see no reason to single out universities for adverse treatment. Section 220 as written would continue to permit other contracting organizations to receive contracts under the exceptions.

We also offer two recommendations, recognizing that both of these may already be in place, at least in certain cases.

First, such projects should be subject to the same rigorous scientific and technical pre-award review and approval as other projects to ensure that the quality of the science relative to the highest quality science is good, including review by outside experts. Such review is especially important when the construction of a permanent facility is proposed.

Second, after projects are funded under this exception, they should continue to be reviewed periodically by ad hoc review panels of experts appointed by the Secretary. Members of these review panels should be drawn from outside the Department and outside the institutions involved. Review panels should consider the benefits of the activity, the continuing need for it and the appropriateness of continuing to fund it under the act. The conclusions and recommendations of the panel should be reported by the Secretary to Congress, and if they do not involve classified activities, they should be made public.

Let me give a brief example with which I am familiar. In May 1984, the Congress created a program called free electron laser technology for medical research to create several regional multidisciplinary resource research centers. In 1985 money was appropriated in the DOD budget to fund five regional university based centers to explore the application of free electron laser technology in the medical and material sciences.

A Vanderbilt University research team from physics, engineering and medicine submitted a proposal which won the national competition where all proposals were judged by teams of peer experts appointed by DOD.

Since then Vanderbilt University has funded the construction of a $2.5 million building, now complete, to house the instrument and associated laboratories. DOD is funding the development of the laser instrument which will be installed later this year. The choice of the specific laser and the design of the facility were also peer reviewed jointly by the Vanderbilt team and a DOD team. At the present time a proposal for the peer review of research projects which are candidates to use this facility is being considered by DOD under the framework and agreements of the original program.

On the one hand, free electron laser research will be directed by DOD to Vanderbilt and other regional centers developed for the purpose. On the other hand, our center was established from proposals submitted in open competition and judged by a DOD appointed peer review panel, and I expect the research conducted on this special instrument to be peer reviewed by other DOD appointed panels on a case-by-case basis.

Obviously, some of the competitors will lose out in the competition. Some may even complain to you, but it is just this kind of open, competitive process that DOD and other agencies of Government can and should use to fund research and research facilities of the highest quality.

And not just DOD. A similar methodology employed several years ago by NSF in the establishment and use of five regional supercomputer centers in which I was directly involved, centers for science research, has also proved to be very successful.

In sum, we support the retention of the CICA exceptions under the continuing and careful review and monitoring of the Secretary of Defense and outside panels as required.

In conclusion, Mr. Chairman, no other industrialized nation relies on its research universities as heavily as we do. University research and education programs are essential to our national economy and our national security. Our research and education programs are truly our first line of defense and our most important asset in the competitive world economy now and for the future.

Research facilities are indispensible to the modern research university. Without proper facilities, universities cannot attract able scholars or perform research at the forefront in the intensely competitive international arena. They cannot provide adequate research service to other participations in the research and economic enterprise including the defense sector.

Our need for facilities is also inextricably linked, as was being discussed a moment ago, to the Nation's need for highly-trained people. We are failing to attract a sufficient number in some departments and disciplines; in some cases it is difficult to attract any of the most talented American students, especially minorities and women, into graduate programs in science and engineering. If we continue to allow the research environment to erode, then we will find it even more difficult to attract the best students into doctoral programs and careers as academic researchers and future faculty.

If America is to sustain a position of world leadership in technology development, long deferred investments in sustaining institutional capabilities for conducting research and training scientists and engineers must be made now. Fresh policies to guide those investments must be formulated and decisions on the allocation of those scarce resources must be made wisely, openly and competitively.

Mr. Chairman, we commend you for your leadership on behalf of the university research community and for your sensitivity to its needs. Thank you for the opportunity to testify.

[The prepared statement and appendices of Mr. Wyatt follow:]

PRESENTED BY

DR. JOE B. WYATT, CHANCELLOR
VANDERBILT UNIVERSITY

ON BEHALF OF

ASSOCIATION OF AMERICAN UNIVERSITIES
ASSOCIATION OF GRADUATE SCHOOLS
COUNCIL OF GRADUATE SCHOOLS
NATIONAL ASSOCIATION OF STATE UNIVERSITIES
AND LAND-GRANT COLLEGES

Mr. Chairman, Members of the Committee:

Introduction and Summary

My name is Joe Wyatt, and I am Chancellor of Vanderbilt University. It is a pleasure to appear before you today to discuss several interrelated issues that concern nation's research universities, the Department of Defense, this Committee and Congress. My testimony is presented on behalf of four leading higher education associations, which together represent virtually all research universities engaged in DOD supported research programs.

The purpose of this hearing, as I understand it, is to consider recent developments in the area of Congressional funding for university research projects and research facilities, including the implications of the amendment to the FY 1989 DOD authorization bill (Section 220 of P.L. 100-456) successfully sponsored last year by Senator Nunn. I will respond to your invitation by briefly discussing four interrelated topics:

- The role of Congress and the role of open, competitive merit review in the award of federal funds for research and research facilities;
- The problems posed for many universities by their unmet research facilities needs;
- Our suggestions for a new national investment strategy for academic research facilities;
- Section 220 of the FY 1989 Defense Authorization Act.

The Role of Congress and the Role of Open Competitive Merit Review in the Award of Federal Funds for Research and Research Facilities

Questions concerning the respective roles of Congress and of open merit-based competition in the award of federal funds for research and research facilities are being discussed in Congress, in the Executive branch and across the university community with renewed urgency. And for good reason. Few questions probe so fundamentally at the roots of our research and education enterprise as these: What federally supported research is to be done in the national interest? Where will it be done? Who will do it, and at what level should it be funded? We also must ask: who answers these questions? How do they make their decisions? And to whom are they accountable? And, finally, we must ask: What is the role of the expert and what is the role of the nonexpert -- the Member of Congress -- in the decision making process?

Congress plays many different and essential roles in the federal research enterprise, and that role is expanding because the importance of science and technology to our national welfare and security continues to grow rapidly. And, predictably, policy and political questions are proliferating in number and complexity. For example, Congress frequently addresses regulatory issues such as the regulation of recombinant DNA research, the use of human subjects and animals in research, environmental issues, the wisdom of controlling scientific communication and the propriety of fetal research. In addition, Congress plays an essential oversight and early-warning role, examining, for example, the implications for our national competitiveness of the expanding cooperation between universities and industry stimulated by recent federal policy initiatives shaped by Congress. Increasingly, Congressional actions in the areas of tax policy, patent and copyright policy and anti-trust policy affect the research enterprise. Finally, of course, Congress most directly affects the federal research enterprise by its annual authorizing and appropriating activities for the research agencies. Congress does all of these things in cooperation with Executive agencies and the public, including the constituents of individual members.

For purposes of this hearing perhaps we can save time and sharpen our focus if we stipulate, and take pride in, two facts: (1) the health of the academic enterprise in science and engineering in the United States is intimately linked with, and dependent upon, decisions made by Congress through virtually all of its budget, tax, authorization, appropriations and oversight functions, and (2) the legislative process, though often complicated and difficult, serves the nation exceedingly well.

The question before us this afternoon, I believe, has most to do with the boundaries - the permeable boundaries - between the legislative domain and the domain of the scientific and technical expert in setting national science policy. Not all science policy issues can best be addressed through the legislative process. As Chairman Nunn and others in Congress have clearly pointed out, there is a point in the process at which political leaders usually and appropriately chose to refrain from involving themselves. They do so because other decision-making mechanisms, accountable to Congress, have proven to produce results that better serve the broader national interest.

In shaping science policy Congress continuously decides where to exercise its authority and where to exercise legislative restraint. And, simultaneously, universities and other participants in the enterprise who present their needs to Congress have a responsibility to participate with Congress in the policy process and to appreciate and respect the role of Congress in shaping national science policy.

The need for judgement and restraint, therefore, is shared by Congress and scientific community. Whenever the vulnerabilities of the legislative process are successfully exploited for gain by individual institutions, I believe we risk eroding the foundation of support for the effective decision-making processes which have made our research enterprise the largest, most productive in the world.

In recent years, we have seen a growing number of institutions approach Members of Congress directly for assistance in securing funding for needed research and academic facilities. The associations which I represent and many other national organizations have opposed such congressionally directed projects, or earmarks. Appended to my testimony are statements adopted by the associations I represent today and several other national organizations (Appendix). The issue continues to be the subject for protracted, even harsh, debate both in Congress and in the academic community. Opinion is divided on the issue. Some ask why organizations such as those I represent today do not impose sanctions on members who engage in the practice. The answer is that these are voluntary organizations. They simply cannot control the behavior of their members or impose sanctions on them. That is why I believe the public interest in the health of our research enterprise will best be served if both Congress and the university community sustain a sense of mutual understanding, respect and self-restraint. I am skeptical of the ability of the university community to impose sanctions, and of the ability of Congress to legislate total solutions to this problem.

As this Committee knows, perhaps the most contentious aspect of the earmarking issue has concerned funding for certain university research facilities. A growing number of institutions--driven by pressing needs, pulled by new opportunities, and constrained by inadequate funds--are turning opportunistically to Congress. A number of institutions have received funds without either a competitive application process or a professional review of the scientific and technical merits of their appeal for federal funds prior to the award of funds. And, I can tell you from personal experience, the pressures felt on many campuses and in many presidents' officers to engage in the practice have grown enormously in recent years. It is becoming steadily more difficult for many to withstand the pressure to turn to Congress as the only possible source of support for essential facilities. In the face of this growing pressure I believe Congress has shown not weakness, but impressive self restraint. However, unless the serious underlying research facilities problem is addressed seriously that self restraint may be tested. The pressure to award far greater sums of federal dollars in this way is growing.

Some couch their argument in favor of the practice in terms of a citizen's right to petition Congress. Surely no one disputes either a citizen's constitutional right to petition Congress or the authority and power of Congress to respond. The debate has never really turned on these constitutional aspects. It has nothing to do with the rights of the parties; it has everything to do with the wisdom of engaging in the practice and its consequences. The debate concerns the wisdom of a decision to turn away established modes of congressional policy-setting for science and away from established orderly planning and budgeting and competitive decision-making processes which have served the country well, toward a more purely political allocation process. The system which has served us well for several decades is predicated on congressionally promulgated goals, objectives and programs implemented by agencies following administrative principles and procedures understood and available to all eligible parties. The system has been refined and shaped to fit the mission requirments of the agencies, but the elements common to them all are open, merit-based, competition and discriminating scientific and technical judgments made by those competent to make them. It is not a perfect system, but it has made the United States a world leader in research and graduate education . And, by its continuing oversight Congress has assisted agencies in improving the operation of their merit review and award systems. For example, several years ago Congress initiated a special competitive program in the National Science Foundation to assist state governments and their universities in developing their capabilties to compete more effectively for federal research funds. The Experimental Program to Stimulate Competitive Research (EPSCOR) now serves 17 states, and significant progress has been made by several states.

Over the years many improvements have been made in the competitive system, and, as a result, healthy differences over policy goals rest on a solid foundation of administrative principles and competitive procedures widely acknowledged to be fair and effective. In short, the system works; it is neither broken nor is it in need of major repair. And, as demonstrated by the EPSCOR program, it can be adapted to meet new policy goals.

The Underlying Problem of Unmet Research Facilities Needs

The increased pressure felt by institutions and by Members of Congress to engage in earmarking of facilities funds can be explained, I believe, primarily by the accumulating facilities needs that hamper research and education programs on many campuses. The problem has been thoroughly documented by several recent studies. Last year, for example, NSF reported that for every $1.00 universities are now spending for repair and renovation of research laboratories, $3.60 is being deferred; for every $1.00 planned for new construction, $2.50 must be deferred. About 40 percent of present laboratory space is in need of renovation and repair. Expansion and replacement needs are substantial. A 1988 report by the Association of Physical Plant Administrators and the National Association of College and University Business Officers, prepared by Coopers and Lybrand, states that the nation's 104 leading research universities alone face *urgent* needs totaling more than $7 billion.

In 1985, the Department of Defense prepared a report, "Selected University Laboratory Needs in Support of National Security", for the House Committee on Armed Services. The report addressed the research facilities needs of a "small subset" of universities heavily engaged in DOD research programs in just five fields: chemistry, electronics, engineering, materials and physics. The Department conservatively estimated that these "key" institutions then faced unmet needs for research facilities, and equipment, of about $700 million in just these selected fields of interest to the Department. The Department's report called for a $300 million, five-year DOD program to address highest priority DOD-related needs and a government-wide initiative to address the broader national problem.

The primary factors contributing to the facilities deficit are summarized in a new report to the National Science Foundation by the Association of American Universities and the National Association of State Universities and Land-Grant Colleges. A copy of the report also is appended to my statement, and we ask that it be made a part of the hearing record. Briefly summarized, in most institutions five factors contribute to the research facilities deficit:

1. The Accelerating Pace of Scientific Progress and Instrumentation Requirements. The nature of science itself continues to change rapidly and the pace of change is accelerating. As these changes occur, the requirements surrounding scientific instrumentation also are changing dramatically, and instruments depend on the facilities that house them. The amount and scale of modern research instruments now require more space per researcher and more sophisticated environments than was generally true only fifteen years ago. Modern scientific instruments have become increasingly expensive, have extremely rapid rates of obsolescence, and raise the additional costs of developing facilities that are adequate for the research and educational needs of the university.

2. The Cost of Providing Laboratory Space for Faculty. Recruitment and retention of faculty is being compromised by research facilities shortcomings. The cost to an institution of recruiting and establishing laboratories for young faculty and recognized researchers is high and going up an a rapid rate. A university frequently can expect to face costs of $250,000, $500,000, or more to equip a young person just beginning a research career. The cost of equipping and renovating a laboratory for a recognized researcher can easily exceed these sums. And, as faculty retire in greater numbers in the middle 1990s, the total costs associated with recruiting and equipping faculty will grow.

3. New Regulations and Standards. Federal, state, and local governments are imposing regulations and building standards that at once render adequate facilities obsolete and add substantial costs. The costs of meeting new health and safety codes are overwhelming to many institutions. Examples include new standards for care and use of research animals; collection, handling, and storage or radioactive, biohazardous,

and toxic wastes; environmental air quality and emission requirements; electrical and fire codes; asbestos removal; and handicapped access. Compliance costs are imposing very substantial financial burdens on institutions, drawing funds away from other pressing institutional needs. This is especially true when such regulatory and code requirements are imposed on old buildings which, in economic terms, should be replaced rather than backfitted. These consequences are largely ignored by federal research funding agencies.

4. Inflexible, Old Buildings. Many research laboratories are housed in old buildings constructed for an earlier era. Many are structurally inflexible and obsolete. Retrofitting old buildings to comply with new regulatory requirements and research needs is inordinately expensive, especially when the work is done piecemeal. Creating high-quality research space in a segment of an old building to accommodate the needs of a single research group is even more costly, because economies of scale are not available. Frequently, it is neither cost effective nor possible to renovate old, inflexible facilities for today's--let alone for tomorrow's--educational and research needs. They must be replaced. Until they are, the quality of the research and education programs housed in these laboratories is compromised.

5. Underfunding. The principal cause of universities' research facility problems, and the primary factor contributing to the growing practice of earmarking, is of course, chronic underfunding. Private and public instituions alike have insufficient resources to meet the high construction costs for new specialized buildings. Many of us responsible for the future welfare of these institutions admit, usually to one another, to feeling a deeper pessimism about our continuing ability to meet the escalating costs of modern research and education programs.

For both private and public institutions, private donor support for facilities is perhaps the most difficult dollar to raise. Prior to the 1986 Tax Act, debt financing was an essential means of financing research facilities for private universities. The Act imposed a $150 million cap on the use of tax-exempt bonds by private universities. As a result, according to the NSF, by next year 14 of 19 private universities among the top 50 in the conduct of federal R&D programs will lose this funding source. Leading private institutions face the costs imposed by the Tax Act of 1986, in terms of both the tax-exempt debt ceiling and giving disincentives placed on private donors. Many public institutions must cope with state budgets that have not kept pace with the escalating demands placed upon them. Industry lacks sufficient incentives to support academic facilities construction and prefers to emphasize research and student support. Under current federal policy, fundraising from individual donors and industry will remain an inadequate response to the demands for facilities construction and modernization.

A 1986 report of the White House Science Council Panel on the Health of U.S. Colleges and Universities, "A Renewed Partnership," recommended that a competitive, matching-grant research facilities program be established in the National Science Foundation funded as a "necessary minimum" at $500 million per year. The panel also noted that federal indirect cost recovery policies, which assume a 50-year useful life for a building and 15 years for research equipment, are outdated. These administrative regulations provide inadequately for the replacement of facilities and instrumentation consumed in federally supported research activities, and they need to be modernized. Recently, an Ad Hoc Committee of the AAU prepared a report, "Indirect Costs a Associated with Federal Research on University Campuses: Some Suggestions for Change." The recommendations of the report have been endorsed by the AAU membership, and we are now discussing these suggestions with others in the research community and with members of the administration.

The impacts of inadequate facilities on research and education programs are easily seen in hampered research programs, frustrated faculty and students, compromised graduate programs and slowed scientific progress. I commend to your attention the specific examples of these effects provided by Appendix D of the AAU/NASULGC report to the National Science Foundation. I also must note, as the associations' report does, that there is growing reason for concern that in at least some research universities competing facilities requirements may be contributing to the erosion of undergraduate instructional laboratories. Since 1963 the Office and then the Department of Education has had statutory authority and responsiblity to address instructional laboratory needs of universities and colleges. However, these authorities have not been funded at meaningful levels since the mid-1970s.

A New National Investment Policy for Academic Research Facilities

Since the middle 1960s, the federal government has lacked a coherent governmentwide investment policy for academic research facilities. All who examined the problem in recent years--including the White House Science Council, the National Academy of Sciences, the Council on Competitiveness, the Council on Research and Technology as well as the university community--are unanimous in the view that the nation needs a new investment strategy for academic research facilities which will require investments incremental to the base of federal research funding. Just a few weeks ago, Dr. Frank Press, President of the National Academy of Sciences called for a governmentwide investment in academic research facilities of $1.25 billion per year. Last year, Congress took a first step by authorizing a new and potentially helpful program in the National Science Foundation. In FY 1990, $125 million is authorized, and $187 million is authorized for FY 1991. Unfortunately, no funds were requested for the NSF program in FY 1990, and no other agency has sufficient statutory authority to initiate needed programs. We are asking the administration to pursue President Bush's intention, which he announced October 25, to address the facilities problem and to do so comprehensively governmentwide.

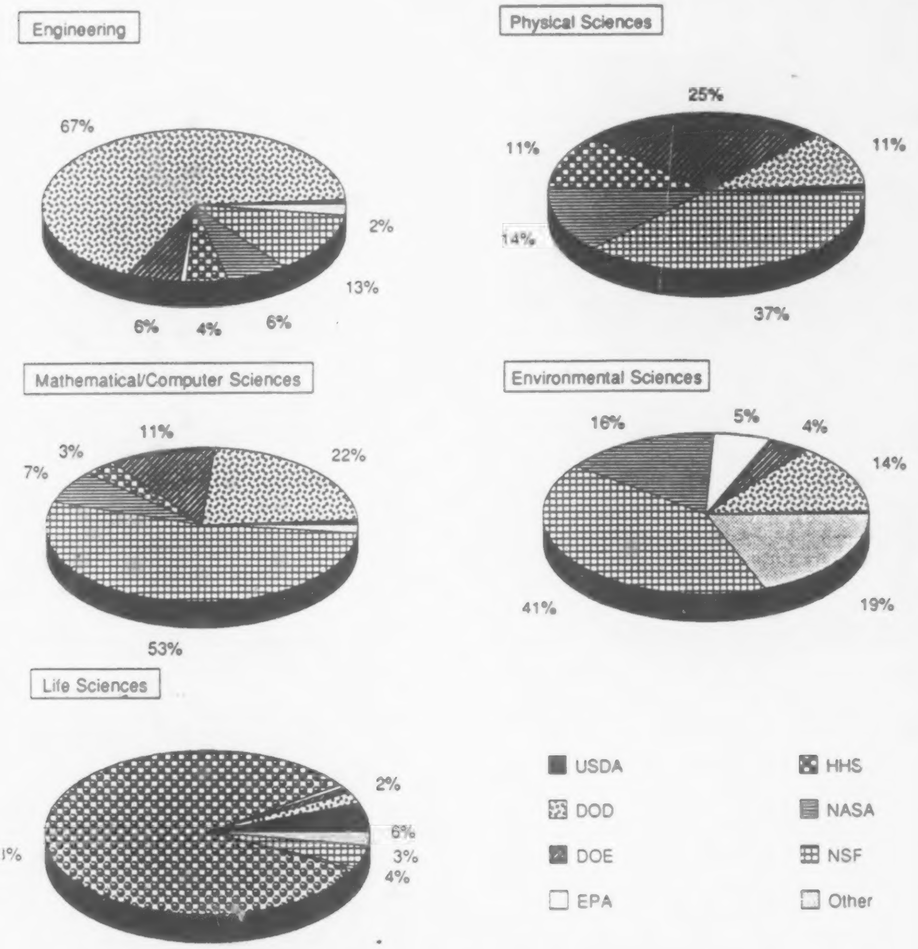
A new national investment strategy is needed. No single policy initiative or unique action by a single agency, such as the National Science Foundation, will suffice. The nation's needs are too great, too complex, and they are shared among institutions that serve varied and diverse roles in the research and education enterprise. We believe that a successful investment strategy will include at least the following elements:

1. Explicit recognition by the Executive Branch that it has a fundamental leadership role and shared responsiblity for the university research infrastructure which houses research programs sponsored by all federal research agencies, including the Department of Defense.

2. New federal policies and improved policy coordination will be necessary. Direct investment in construction and modernization of laboratories through competitive, matching and leveraged federal grant programs is required. Indirect investment throught the modernization of costing policies, removal of the statutory cap on tax-exempt bonding for private universities and strengthened tax incentives for industry to invest in academic research facilities also is needed. No single policy or funding mechanism can effectively target scarce federal resources where federal priorities require them and meet the needs of different research performing institutions equitably and effectively. A combination of direct and indirect investment policies will enable policy makers to tailor policies and programs to the needs of diverse institutions in ways consistent with national research priorities, agency objectives, and long-term national needs.

Obligations to Universities and Colleges for R&D in Five Fields, FY 1987

	USDA	DOD	DOE	EPA	HHS	NASA	NSF	Other	Total
Engineering	11,978	657,780	56,448	6,795	43,036	63,831	124,847	22,155	986,870
Physical Sciences	11,401	93,594	204,263	1,849	92,826	112,113	304,450	3,639	824,135
Mathematical/Computer Scien	2,200	43,900	21,769	294	6,293	13,716	104,549	3,041	195,762
Environmental Sciences	2,416	68,963	21,260	26,945	0	77,470	203,593	95,797	496,444
Life Sciences	237,979	91,139	40,832	25,348	3,341,524	19,957	165,607	112,090	4,034,476



Source: National Science Foundation; derived from "Federal Obligatiosn to Universities and Colleges for Research and Development by Detailed Field and Agency: Fiscal Year 1987".

3. A substantial initial commitment and steady annual growth in governmentwide investment in facilities construction and modernization is needed. Investments must be planned for and budgeted as integral elements of federal R&D activities and as incremental to each agency's research base. To begin, we suggest that each of the leading research agencies (HHS, DOD, DOE, NASA , USDA and NSF) establish companion, merit-based, competitive, matching grant programs for the construction and modernization of university labotratories and that they target those programs on the fields of science and engineering that serve each agency's mission. For example, according to the most recently available data from NSF, presented in the following .exhibit, in FY 1987 DOD accounted for 67% of total federal R&D obligations to universities and colleges in engineering, 22 % in the mathematical and computer sciences, 14% in environmental sciences and 11% in the physical sciences. In these fields DOD and the National Science Foundation together account for 80%, 75% and 48% respectively of total federal R&D obligations to universities and colleges. Therefore a compelling case can be made that the Department ought to be provided with the necessary statutory authority and direction to play a role jointly with NSF, and with DOE and NASA, in addressing the pressing needs of laboratories in engineering, mathematical/computer sciences and physical sciences. It could do so in ways consistent with its mission requirements and the needs of its ongoing research programs. Mechanisms to facilitate interagency cooperation, coordination and funding governmentwide effort also will be needed.

Some argue that research agencies cannot afford to undertake new research facilities programs. We certainly agree that resources for academic science are increasingly scarce. However, we also note that since 1984 Congress has appropriated through the Department of Defense around $300 million for specific institutions. Similar sums have been appropriated through the Department of Energy, and additional substantial awards have been made through other agencies. We are not aware that any of these awards required matching funds from nonfederal sources as did the previously established agency programs. In the context of this recent experience, organized investments at the levels suggested above seem reasonable and desireable, especially in this constrained budgetary climate.

Establishing organized competitive programs will not necessarily end the practice of earmarking that concerns many of us and this Committee. I do believe, however, that virtually all institutions will prefer to compete openly for funds if they believe that they have a reasonable chance of success in a competition with like institutions and that adequate investments will be made. Competitive matching grant programs have a proven ability to target resources on institutions in need of them while simultaneously leveraging state government and university funds. The partnership concept has worked well in the past. It can do so again.

Section 220

Turning briefly to Section 220, we commend Chairman Nunn and the members of this Committee for your leadership in seeking a means to ensure that competitive procedures are followed when grants or contracts are awarded to colleges and universities. We understand the objectives of the provision, and we applaud the intention to curb the practice of earmarking using the funds of the Department of Defense. We are concerned, however, that the effects of Section 220 will be damaging to research universities, including some institutions which entered into unique arrangements with the Department more than 40 years ago as part of the World War II effort. These institutions entered into long-term arrangments with the Department because they possessed essential capabilities. When Congress enacted the Competition in Contracting Act (CICA) it recognized the need to provide the Department authority to enter into such contractural arrangements in exeptional circumstances. It is our understanding that the exceptions to the CICA, which were supported by the AAU in testimony presented by the President of AAU, Robert Rosenzweig, have served their intended purpose; we know of no evidence that they have been employed inappropriately, although we recognize the potential for abuse. We also see no reason to single out universities for such treatment. Section 220 would continue to permit other contracting organizations to receive contracts under the CICA exceptions. Finally, we note that the provision uniquely applies to DOD relative to other federal agencies. We ask that when institutions can appropriately be awarded contracts under the exceptions specified by the statute, they be permitted to do so.

We also offer two recommendations, recognizing that both of these may already be in place, at least in certain cases. First, such projects should be subject to the same rigorous scientific and technical pre-award review and approval as other projects to ensure that the quality of the science relative to the highest quality science is good, including review by outside experts. Such review is especially important when the construction of a permanent facility is proposed. Second, after projects are funded under the CICA exceptions they should continue to be reviewed periodically, i.e., every three to five years, by ad hoc review panels of experts appointed by the Secretary. Members of these review panels should be drawn from outside the Department and outside the institutions involved. Review panels should consider the benefits of the activity, the continuing need for it and the appropriateness of continuing to fund it under the Act. The conclusions and recommendations of the panels should be reported by the Secretary to Congress, and, if they do not involve classified activities, they should be made public.

We support retention of the CICA exceptions, under the continuing and careful monitoring of the Secretary of Defense and the Armed Services Committees of Congress.

Conclusion

In conclusion, Mr. Chairman, no other industrialized nation relies on its research universities as heavily as we do. University research and education programs are essential to our national economy and our national security. Our research and education programs are truly our first line of defense.

Research facilities are indispensable to the modern research university. Without proper facilities, universities cannot attract able scholars or perform research at the forefront in the intensely competitive international arena. They cannot provide adequate research services to other participants in the research and economic enterprise, including as the defense sector. They cannot maintain that constant base of independent investigation so essentiual to advances in knowledge. They cannot perpetuate the essential cross-fertilization of ideas or assist as effectively in the development of new technologies.

Our need for facilities also is inextricably linked to the nation's need for highly trained people. We are failing to attract a sufficient number--in some departments, any of the most talented U.S. students, especially minorities and women, into graduate programs in science and engineering. If we continue to allow the research environment to erode, then we will find it even more difficult to attract the best students into doctoral programs and careers as academic researchers and faculty.

If the U.S. is to sustain a position of world leadership in technology development, long-deferred investments in sustaining institutional capabilities for conducting research and training scientists and engineers must be made now. Fresh policies to guide those investments must be formulated. And, decisions on the allocation of those scarce resources must be made wisely, openly and equitably.

Mr. Chairman, we commend you for your leadership on behalf of the university research enterprise and for your sensitivity to its needs. Thank you for the opportunity to testify before you. I will be pleased to respond to your questions.

APPENDICES

University Research Facilities:
A National Problem Requiring a National Response

The Ad Hoc Committee on Academic Research Facilities

Association of American Universities
National Association of State Universities and Land-Grant Colleges

June 1989

AAU
NASULGC

June 7, 1989

Mr. Richard J. Green
Director, Research Facilities Office
National Science Foundation
1800 G Street, NW
Room 1240
Washington, DC 20550

Dear Dick:

You recently invited us to assist your office in responding to questions posed to the National Science Foundation by Congress on the academic research facilities needs of universities. We are pleased to send you the enclosed brief report, prepared by a joint AAU/NASULGC ad hoc committee. In preparing the report the committee relied on the views of more than forty universities who responded expeditiously to questions we posed to them.

The report offers a framework for a comprehensive, government-wide investment strategy for the modernization of academic research laboratories, provides a supporting rationale for renewed national investment and identifies the need for related policy analysis. In addition, Appendix E of the report presents statements by responding universities on their facilities needs, and the consequences of those unmet needs for research and education programs, in six fields: biological sciences, chemistry, engineering, environmental sciences, materials sciences, and physics. Together these statements are a fresh and, we believe, convincing statement on the need to move promptly toward the new policies and programs called for by our report.

Thank you for the opportunity to be of assistance to you. We would be pleased to discuss the report further with you and your colleagues.

Sincerely,

Jack
John C. Crowley
Vice President
Association of American Universities

Bob Clodius
Robert L. Clodius
President
National Association of State Universities
and Land-Grant Colleges

JCC/RLC/dml

Enclosure
cc: William Cole
Altie Metcalf

University Research Facilities: A National Problem Requiring a National Response

The Ad Hoc Committee on Academic Research Facilities

Association of American Universities
National Association of State Universities and Land-Grant Colleges

June 1989

Introduction

The National Science Foundation shortly will submit to Congress a report on academic research facilities. The report will address questions posed by Congress last year in the Foundation's FY 1989-FY 1993 Authorization Act, which, in part, established a new NSF Academic Research Facilities Modernization Program. Recently, in preparation for that report, the Foundation's Research Facilities Office invited AAU and NASULGC to address several issues related to research facilities needs of universities. In late April AAU and NASULGC prepared and distributed ten questions (Appendix A) to the executive heads of 56 AAU member institutions and the NASULGC legislative network with a request for a response within two weeks; 45 universities responded (Appendix B).

On May 17 an ad hoc committee (Appendix C) met with Mr. Richard Green, Director, and Mr. William Cole, Executive Officer, of the Foundation's Research Facilities Office. The Committee, informed by the responses of our member institutions, then prepared this brief response to the Foundation's request for the associations' views. Volumes could be written in response to the questions posed; in fact, several already have been written, and so we do not intend to replow fit ground. Instead, this summary statement attempts to restate briefly the context and consequences of the academic research facilities deficit, to highlight the factors contributing to the problem, and to suggest an appropriate policy framework to respond to it.

The associations extend their appreciation to all who answered their request for assistance. The Ad Hoc Committee made extensive use of those responses.

Organization of This Report

Our report is organized as follows:

- I. A National Investment Policy for Academic Research Facilities
- II. Questions Requiring Further Analysis
- III. The Rationale for Action:
  - A. The Mission of the Modern Research University
  - B. Factors Contributing to the Research Facilities Deficit
    - 1. The Accelerating Pace of Scientific Progress and Instrumentation Requirements
    - 2. The Cost of Providing Laboratory Space for Faculty
    - 3. New Regulations and Standards
    - 4. Inflexible, Old Buildings
    - 5. Underfunding
  - C. Impact on Research and Education Programs
- IV. Conclusion

Appendices

- A. Questions Posed by AAU/NASULGC Ad Hoc Committee on Academic Research Facilities
- B. Universities Responding to Questions Posed by AAU/NASULGC Ad Hoc Committee on Academic Research Facilities
- C. Association of American Universitie/National Association of State Universities and Land-Grant Colleges Ad Hoc Committee on Academic Research Facilities
- D. Highlights of Recent Surveys on Academic Research Facilities
- E. Statements by Public and Private Universities on Research Facilities Needs in Six Fields

I. A National Investment Policy for Academic Research Facilities

In our judgment, the research university community is unanimous in the view that the nation needs a new national investment strategy for academic research facilities which will require investments incremental to the base of research funding. No single policy initiative or unique action by a single agency will suffice. The nation's needs are too complex, and they are shared among institutions that serve varied and diverse roles in the research and education enterprise. Although further analysis of the interrelationships and effects of possible policy elements is needed, we believe that a successful investment strategy will include at least the following elements:

– First, explicit recognition by the Executive Branch that it has a fundamental leadership role and shared responsibility for the university research infrastructure which houses research programs sponsored by all federal research agencies.

– Second, a mixed investment strategy is required. New federal policies and improved policy coordination will be necessary to provide for both ***direct*** federal investment in the construction and modernization of university research laboratories (through competitive, matching, and leveraged grant programs) and for ***indirect*** federal investment (through modernization of the facilities and equipment provisions of OMB Management Circular A-21, removal of the statutory cap on tax-exempt bonding for private universities, and strengthened tax incentives for industry to invest in academic research laboratories).

Direct and indirect modes of investment, used in concert, will serve two objectives: (1) scarce resources will be more effectively targeted where federal priorities require them, and (2) the needs of all research-performing institutions will be met equitably and effectively. No single policy or funding mechanism can achieve both objectives. A mixed investment strategy will directly assist institutions in addressing their well-documented backlogs of construction and modernization needs, and adjust federal costing and tax policies to provide for balanced and sustained long-term investment in research facilities. A combination of direct and indirect investment policies will enable policy makers to tailor investment policies and funding programs to the needs of institutions in ways consistent with national research priorities, agency objectives, and long-term national needs.

– Third, a substantial initial commitment and steady annual growth in governmentwide investment in facilities construction and modernization.

Facilities investments must be planned and budgeted as integral to total federal R&D activities and as incremental to each agency's research base. For example, in FY 1991, governmentwide investment in academic research facilities, through both ***direct*** and ***indirect means***, should equal a minimum of 1 percent of total federal R&D, or approximately $700 million. Total investment should be increased incrementally between FY 1992 and FY 1995 until at least $2 billion—a sum likely to equal slightly more than 2 percent of total R&D in federal FY 1995—is invested by both ***direct*** and ***indirect*** means.

To begin, we suggest that each of the leading research agencies (HHS, DOD, DOE, NASA, and USDA) be encouraged by NSF to establish companion, merit-based, competitive, matching grant programs for the construction and modernization of university laboratories in fields that serve each agency's mission. Mechanisms to facilitate interagency cooperation and coordination also will be needed. Since only NSF now has sufficient statutory authority to implement such a program, we further suggest that the Foundation encourage each agency to request the necessary authorizations and appropriations as part of the FY 1991 budget request. We especially encourage NSF to request the full authorized amount ($187.5 million) to begin its Academic Research Facilities Modernization Program in FY 1991.

Competitive matching grant programs have a proven ability to target resources on institutions in need of them while simultaneously leveraging state government and university funds. The partnership concept has worked well in the past and, within limits, it can do so again. We believe that most universities will support a 1:1 or 50/50 match. However, agencies also must recognize that similar matching requirements on universities have expanded substantially in recent years. As a result, many research-intensive institutions, already severely extended, will find even a 50/50 matching requirement a stiff challenge. We, therefore, strongly caution against imposing on universities more stringent matching requirements.

II. Questions Requiring Further Analysis

We believe that a mixed investment strategy along the lines suggested above will prove to be the optimal federal response to the research facilities deficit. However, policy makers will be interested in the interactive and distributional effects, and the likely long-term consequences to U.S. science, of combinations of direct and indirect investment strategies. Presently, we lack an analytical model with which to perform useful "if-then" analyses of the operational effects of a mixed investment strategy. We suggest that NSF develop such an interactive analytical model to analyze the consequences of policy and investment alternatives.

III. The Rationale for Action:

A. The Mission of the Modern Research University

No other industrialized nation relies on its research universities as heavily as does the U. S. University research and education programs are essential to our national economy and our security. Entire sectors of our economy, such as agriculture and electronics, are dependent primarily upon universities for new knowledge creation, new technology development, technology transfer, and the continuing supply of a highly educated work force.

Research facilities are indispensable to the mission of the modern research university. They are critical to the maintenance of productive research and education programs. Without proper facilities, universities cannot attract able scholars or perform research at the forefront in the intensely competitive international arena. They cannot provide adequate research services to other participants in the research and economic enterprise. They cannot maintain that constant base of independent investigation so essential to advances in knowledge. They cannot perpetuate the essential cross-fertilization of ideas or assist as effectively in the development of new technologies. And, the demand for knowledge and technology now far exceeds our production capacity. Since NSF compiles and publishes the leading quantitative indicators of the contributions of research universities to our national life, we do not repeat them here.

Our need for facilities is in inextricably linked to the nation's need for highly trained people. We simply are failing to attract a sufficient number—in some departments, any—of the most talented U.S. students into graduate programs in science and engineering. The problem, especially with regard to minorities, women, and the handicapped, is widely reported and generally accepted. The research environment in universities is one component, and an essential component, of the problem. If we continue to allow this environment to erode—and it is eroding in many leading institutions despite their best efforts—then we will find it even more difficult to attract the best students into doctoral programs and careers as academic researchers and faculty.

In the last analysis, a failure to invest sufficiently in research facilities will have potentially disastrous consequences for the national economy and our long-term national security. As the White House Science Council concluded in its report, A New Partnership, and as Dr. Frank Press, President of the National Academy of Sciences, recently confirmed, our universities cannot sustain their capabilities in the absence of national leadership and strengthened national investment. If the U. S. is to sustain a position of world leadership in technology development, long-deferred investments in sustaining institutional capabilities for conducting research and training scientists and engineers must be made now. In addition, fresh policies to guide those investments must be formulated.

B. Factors Contributing to the Research Facilities Deficit

The leading contributing factors to the academic research facilities deficit are the accelerating pace of science and the requirements of the new research instrumentation; the cost of providing laboratory space for faculty; the impact of new regulations and building standards; the burden of inflexible, old buildings; and chronic underfunding.

1. The Accelerating Pace of Scientific Progress and Instrumentation Requirements

The nature of science itself continues to change rapidly and the pace of change is accelerating. As these changes occur, the requirements surrounding scientific instrumentation also are changing dramatically, and instruments depend on the facilities that house them. The amount and scale of modern research instruments now require more space per researcher and more sophisticated environments than was generally true only fifteen years ago. Modern scientific instruments have become increasingly expensive, have extremely rapid rates of obsolescence, and raise the additional costs of developing facilities that are adequate for the research and educational needs of the university.

Some programs, for example, now use hazardous chemicals, infectious disease agents, microorganisms, bio-agents, and other materials. Simple, old-fashioned biology and chemistry laboratories cannot accommodate such programs safely. Emerging technologies, such as biotechnology, supercomputing, optoelectronics, and molecular biology, require specialized environments, which, in many cases, cannot be accommodated at all by present facilities.[1]

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[1] Research in the natural sciences, biological sciences, engineering, and related fields increasingly requires facilities that have the following features:
- mechanical systems that can maintain air changes, temperature, and humidity under a variety of conditions within a particular building where the research may involve wet chemistry work with hazardous materials, P3 requirement conditions for working with hazardous biological or radioactive materials, and ultra clean conditions that eliminate dust or other materials that can impact the environment or the research experiments;
- electrical systems that provide vast quantities of stable voltage and current at different levels of service (110 volts, 220 volts);
- adequate plumbing;
- vibration-free spaces, often shielded from electromagnetic forces, and building structures that have the capacity to carry heavy floor loads;
- compliance with safety and environmental code requirements as well as various societal requirements (e.g., accessibility for the physically impaired);
- building space design responsive to human interaction and personal security;
- facilities capable of reliably sustaining research activities twenty-four hours a day, seven days a week in circumstances where high penalties are associated with system failure.

Interdisciplinary research to address national needs and opportunities also frequently requires new facilities and additional space. New economies of scale must be achieved in, for example, waste management and shared equipment. Interdisciplinary research teams often require flexible facilities that allow for simple modification to pursue new projects; many existing laboratories were not designed with such flexibility in mind.

Collaborative research projects with industry and national laboratories are expanding in number and significance. These frequently require specialized facilities, including additional space to house team members temporarily working on projects in university laboratories, which industry typically does not provide. Facility inadequacies may limit a university's ability to engage in such collaborative work.

2. The Cost of Providing Laboratory Space for Faculty

Inquisitive and active faculty are essential to the quality of research and the education an institution delivers. Most public and private universities responding report that recruitment and retention of faculty is being compromised by research facilities shortcomings. The cost to an institution of recruiting and establishing laboratories for young faculty and recognized researchers is high and going up at a rapid rate. A university frequently can expect to face costs of $250,000, $500,000, or more to equip a young person just beginning a research career. The cost of equipping and renovating a laboratory for a recognized researcher can easily exceed these sums. And, as faculty retire in greater numbers during the middle 1990s, the total costs associated with recruiting and equipping new faculty will grow.

3. New Regulations and Standards

Federal, state, and local governments are imposing regulations and building standards that at once render adequate facilities obsolete and add substantial costs. The costs of meeting new health and safety codes are overwhelming to many institutions. Examples include new standards for care and use of research animals; collection, handling, and storage of radioactive, biohazardous, and toxic wastes; environmental air quality and emission requirements; electrical and fire code; asbestos removal; and handicapped access. Compliance costs are imposing very substantial financial burdens on institutions, drawing funds away from other pressing institutional needs. This is especially true when such regulatory and code requirements are imposed on old buildings which, in economic terms, should be replaced rather than backfitted. These consequences are largely ignored by federal research funding agencies.

4. Inflexible, Old Buildings

Many research laboratories are housed in old buildings constructed for an earlier era. Many are structurally inflexible and obsolete. Retrofitting old buildings to comply with new regulatory requirements and research needs is inordinately expensive, especially when the work is done piecemeal. Many such buildings cannot easily be modified to facilitate new research activities with specialized equipment needs. Retrofitting expensive support systems (e.g., ventilation hoods, waste disposal facilities, de-ionized water, climate controls, power, heating, air conditioning, and air decontamination, as well as high-speed data communication) is difficult and costly.

Individual faculty members often secure limited alteration/renovation funds for their specific laboratories, but funds are not available for upgrading buildings which house those individual laboratories. Creating high-quality research space in a segment of an old building to accommodate the needs of a single research group is even more costly, because economies of scale are not available. In such a situation, the cost per square foot of usable space can be several multiples of what it would cost to produce the space, on average, in a large, new building project.

Frequently, it is neither cost effective nor possible to renovate old, inflexible facilities for today's—let alone for tomorrow's—educational and research needs. They must be replaced. Until they are, the quality of the research and education programs housed in these laboratories is compromised.[2]

5. Underfunding

The principal cause of research facility problems reported by all responding institutions is, predictably, chronic underfunding. Private and public institutions alike have insufficient resources to meet high construction costs for new specialized buildings. Respondents in both sectors reflect an aura of pessimism about their future ability to meet the facilities costs required by modern research and education programs. Leading private universities emphasize the costs imposed by the Tax Act of 1986, in terms of both the tax-exempt debt ceiling, which has made debt a more expensive proposition for many of them, and giving disincentives placed on private donors. Public institutions report that many state budgets have not kept pace with the escalating demands placed upon them. Some states seem to have adopted the attitude that research facilities are the responsibility of the federal government, since the latter is the primary patron of the nation's basic research enterprise.

For both private and public institutions, private donor support is perhaps the most difficult dollar to raise. Industry lacks sufficient incentives to support academic facilities construction and prefers to emphasize research and fellowship support. Under current federal policy, fund raising from individual donors and industry will remain an inadequate response to the demands for facilities construction and modernization.

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[2] The following examples, are, we believe, quite typical of situations commonly found on leading university campuses:

"A three story electrical engineering building built in 1962 for a cost of $2 million, has been upgraded in air handling capability twice during the past five years. The cost of the new air handling facilities was over $4 million or twice the original cost of the building. However, the building remains inadequate for the research in engineering that is housed in the building. The facility must be upgraded in power, water, vibration, and in air to be useful. The estimated cost for the upgrade is more than $11 million."

Source: Stanford University

"In January 1988 the University of Washington retained two prestigious architectural firms, the NBBJ Group and TRA Associates, to study its science and engineering facilities. Among the conclusions reported by this study are the following:

A. The need for additional space for science and engineering at the University of Washington in the next 15 years totals 527,000 assignable square ft. (ASF) under a 'no growth scenario,' or 867,000 ASF under a 'modest growth scenario.' These numbers correspond to an increase of 32% and 52% respectively.

B. The physics building was described as follows: 'Physics Hall, built in 1928, is the main physics laboratory and teaching facility at the University of Washington. It is unfit for the conduct of modern science. It lacks the capability to accommodate heavy equipment in laboratories and would require major structural improvements to handle additional floor loads and meet seismic standards. Other problems pose threats to the safety of its occupants: unenclosed exit stairs would act as chimneys in event of a fire; adequate electrical power is not available in many laboratories; and some labs illegally vent into corridors.' Bagley Hall, the building which houses the Department of Chemistry, is, in general, in worse condition than the physics building."

Source: The University of Washington

As also noted by the report of the White House Science Council, federal indirect cost recovery policies, which assume a 50-year useful life for a building and 15 years for research equipment, are outdated; they provide inadequately for the replacement of facilities and instrumentation consumed in federally supported research activities.

C. Impact on Research and Education Programs

Several recent reports by the National Science Foundation and others document the condition and needs of universities for academic research facilities. A summary of recent findings is provided in Appendix D. To expand on these findings, respondents provided brief descriptions of the effects of obsolete research laboratories on selected research and education programs. Appendix E provides representative statements in the fields of chemistry, biological sciences, physics, engineering, materials research, and environmental research. Responses addressing other fields have been omitted to conserve space, but the themes of those statements are the same: hampered research programs, frustrated careers, compromised graduate programs, and slowed scientific progress.

Most respondents also reported that obsolete research facilities adversely affect the quality of their graduate programs. It is fair to conclude, we believe, that the quality of graduate programs in the sciences and engineering in many institutions is being compromised by inadequate research facilities.

The Committee spent considerable time discussing the responses of institutions concerning the deteriorated condition of their undergraduate instructional laboratories. Three institutions reported being told by undergraduates that their university instructional laboratories are inferior to those in the high schools they attended. Recently, a chairman of a state coordinating board for higher education told a leading public university that its undergraduate instructional laboratories are "distinctly inferior" to the inadequate laboratories of the high school attended by his son. We are, therefore, concerned that in at least some universities competing facilities requirements may be contributing to the erosion of undergraduate instructional laboratories.

The Department of Education has statutory authority and responsibility, under Title VII of the Higher Education Act of 1965, to address the instructional laboratory needs of universities and colleges. However, Title VII has not been funded at meaningful levels since the mid-1970s. The Department is the most appropriate federal agency to bring national attention and leadership to bear on the problems posed by institutions' instructional laboratory needs. Therefore, we encourage NSF and the Department to collaborate on an appropriate DOE response to the instructional facilities problem in FY 1991.

IV. Conclusion

Responding universities appear unanimous in the view that no additional surveys, studies, or reports documenting the need for research facilities are required. Action to provide serious, organized programs for the construction and modernization of academic laboratories ought to be the next, prompt step.

APPENDICES

Appendix A

Questions Posed by AAU/NASULGC Ad Hoc Committee on Academic Research Facilities

UNIQUE CIRCUMSTANCES AND RESEARCH FACILITY NEEDS OF RESEARCH UNIVERSITIES

DIRECTIONS: Please answer each question on a separate page and on each page give the name of the institution and the name and telephone number of the respondent.

1. What are the unique (a) circumstances, (b) characteristics, and (c) needs of research universities for the modernization or replacement of research facilities?

2. What factors contribute to the research facilities problems of research universities?

3. How do research facilities needs relate to the unique mission of universities in the national research enterprise? How will they affect the nation's future ability to meet national research and education needs? Where does addressing this problem rank in priority with competing priorities, issues, and opportunities?

4. Briefly describe specific examples of research and education programs on your campus now adversely affected by obsolete research laboratories. Are lines of research being impeded? If so, give two or three specific examples in different fields, and for each briefly state the perceived consequences for the institution's programs and the national effort in these fields.

5. Is the quality of education programs at either (a) the undergraduate level or (b) the graduate level being compromised by unmet facilities needs? Are recruitment and retention of faculty being affected adversely? If so, briefly discuss specific examples.

6. What effects do unmet facilities needs have on the capabilities of the university to work collaboratively with others, especially with industry and national laboratories?

7. What are the appropriate roles of federal agencies, universities, state and local governments, private industry, and private foundations in addressing facilities needs? In your experience what funding mechanisms are most appropriate to each sector? Do new or innovative funding mechanisms hold promise for others?

8. What impact will matching requirements for federal facilities funds have on your institution's ability to leverage other sources of support?

9. Are additional data or information needed from federal research agencies or others to enable universities to respond more effectively to their research facilities needs?

10. Additional views.

Appendix B

UNIVERSITIES RESPONDING TO QUESTIONS POSED BY AAU/NASULGC AD HOC COMMITTEE ON ACADEMIC RESEARCH FACILITIES

BRANDEIS UNIVERSITY
BROWN UNIVERSITY
CARNEGIE MELLON UNIVERSITY
CASE WESTERN UNIVERSITY
CATHOLIC UNIVERSITY OF AMERICA
COLORADO STATE UNIVERSITY
COLUMBIA UNIVERSITY
CORNELL UNIVERSITY
DUKE UNIVERSITY
IOWA STATE UNIVERSITY
JOHNS HOPKINS UNIVERSITY
MICHIGAN STATE UNIVERSITY
MISSISSIPPI STATE UNIVERSITY
NEW YORK UNIVERSITY
NORTHWESTERN UNIVERSITY
PENNSYLVANIA STATE UNIVERSITY
PURDUE UNIVERSITY
RICE UNIVERSITY
RUTGERS UNIVERSITY
STANFORD UNIVERSITY
SYRACUSE UNIVERSITY
UNIVERSITY AT BUFFALO
UNIVERSITY OF CALIFORNIA
UNIVERSITY OF CALIFORNIA, LOS ANGELES
UNIVERSITY OF CHICAGO
UNIVERSITY OF FLORIDA
UNIVERSITY OF ILLINOIS
UNIVERSITY OF IOWA
UNIVERSITY OF KANSAS
UNIVERSITY OF MARYLAND
UNIVERSITY OF MICHIGAN
UNIVERSITY OF MINNESOTA
UNIVERSITY OF MISSOURI
UNIVERSITY OF NEBRASKA
UNIVERSITY OF NORTH CAROLINA
UNIVERSITY OF PITTSBURGH
UNIVERSITY OF ROCHESTER
UNIVERSITY OF SOUTH CAROLINA
UNIVERSITY OF SOUTHERN CALIFORNIA
UNIVERSITY OF TEXAS-AUSTIN
UNIVERSITY OF VIRGINIA
UNIVERSITY OF WASHINGTON
UNIVERSITY OF WISCONSIN
VANDERBILT UNIVERSITY
YALE UNIVERSITY

Appendix C

Association of American Universities
National Association of State Universities and Land-Grant Colleges
Ad Hoc Committee on Academic Research Facilities
May, 1989

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Appendix D

Highlights of Recent Surveys on Academic Research Facilities

NSF[1]

It would cost approximately $3.6B to undertake all the repairs and renovations needed in university research facilities for 1988 and 1989 alone.

- 39% of all research space is judged to be in need of limited or major repair to be used effectively.
- Institutions defer about $2.50 of needed construction for every $1.00 of construction that is planned.
- $3.60 in need repair/renovation is being deferred for every $1.00 of repair/renovation that is planned.
- Of the 19 private universities in the top 50 in R&D, 11 have reached the $150M cap in tax-exempt bonds and another 3 anticipate doing so in the next 2 years.
- According to heads of academic departments, the disciplines with the greatest proportion of space in need of major or limited repair were agricultural sciences (46%), environmental sciences (41%), and the medical and physical sciences (40%).

White House Science Council[2]

> *"Our universities today simply cannot respond to society's expectations for them or discharge their national responsibilities in research and education without substantially increased support."*

- WHSC estimates that *$10B is the necessary minimum* over the next 10 years for university facilities and equipment.

Recommends NSF establish an academic research facilities program, funded at $500M, with awards based on peer review and granted on a 50/50 matching basis.

NIH[3]

Study focuses on biomedical research facilities. Among academic institutions:

- Current space for medical sciences was described as "inadequate" by 37-45% of institutions, and 46-51% described biological space as inadequate.

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1. Scientific and Engineering Research Facilities at Universities and Colleges: 1988, National Science Foundation.
2. A Renewed Partnership, A Report of the White House Science Council, 1986.
3. The Status of Biomedical Research Facilities: 1988, NIH.

- Cost per square foot for research space increased from $265 to $307 over a 2-year period, largely as a result of increased technical and regulatory requirements.
- To be used effectively, 38% of space needs limited or major repair/renovation.
- Deferred construction for academic institutions amounts to $1.63 in needed-but-not-planned construction for every $1.00 of planned construction. The comparable figure for hospitals is $3.73, and for research organizations, $7.71.

NACUBO/APPA[4]

"America's deteriorating college and university facilities require substantial capital investment. With an estimated $60 to $70B in capital renewal and replacement needs, some $20B of which is urgent or priority in nature, the reinvestment requirements are staggering."

- Classroom, laboratory, and library space are most frequently cited priorities for construction and renovation.
- Most institutions rely primarily on tax-exempt bonds and state funding to finance their capital needs.
- The largest part of *urgent* needs belongs to the nation's 104 research universities, with an estimated need of $7.2B.
- Approximately 60% of the funds needed in 1987 came from tax-exempt bonds and state funding (primarily among public research institutions).
- About 45% of the funds needed in 1988 for construction and renovation projects came from tax-exempt bonds and state funds.
- More attention needs to be paid to capital renewal and replacement.
- Institutional level: governing boards must take existing facility needs into account when making resource decisions.
- National level: government, higher educational institutions, and individual institutions need to combine efforts.

Prepared by David M. Arfin, AAU Staff
April 17, 1989

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[4] The Decaying American Campus: A Ticking Time Bomb. A joint report of the Association of Physical Plant Administrators and the National Association of College and University Business Officers, by Coopers and Lybrand, 1988.

APPENDIX E

STATEMENTS BY PUBLIC AND PRIVATE UNIVERSITIES ON RESEARCH FACILITIES NEEDS IN SIX FIELDS

Biological Sciences 1
Chemistry 6
Engineering 9
Environmental Sciences 15
Materials Sciences 16
Physics 17

Biological Sciences

BRANDEIS UNIVERSITY

Further research programs in these areas are hampered at Brandeis University. There is now no further available space anywhere in the current buildings for increased research activities due to limitations on the facility. Currently, hallways are being used for desks, freezers, refrigerators, centrifuges and other equipment. The last shell space is being renovated to house a new Structural Biology group. Teaching labs, where possible, are being converted to research space.

CASE WESTERN UNIVERSITY

In the area of genetics, until recently research using animals was focused on drosophila (fruit flies) and bacteria in culture. Recent breakthroughs have made it possible to move to a mammalian model (the mouse) but very large colonies are required. Until an institution can find the resources to invest in the animal facility environments to support such laboratory animals, research cannot be conducted in this area. Although limited, support for animal facilities improvement or creation of facilities for AIDS research from N.I.H. has been a very important government initiative to help make this type of research possible.

THE JOHNS HOPKINS UNIVERSITY

AIDS: A large program of AIDS and AIDS-related research at Johns Hopkins is limited and impeded by obsolete facilities, and modernization and renovation funding is largely unavailable. Research involving the live HIV virus requires P3 (Physical Containment Level 3) laboratory facilities: isolation laboratories with negative air pressure control and maintenance capability; air locks; emergency isolation capability; separate and isolated ventilation systems; lockers and showers for staff; special aerosol containment hoods; non-public thoroughfares and hallways; etc. The present Hopkins research faculty would probably expand AIDS research activities to nearly double its present level (approximately $30 million annual expenditures) if it were possible to upgrade present facilities. Faculty simply do not respond to requests for research proposals in areas of high interest to them because of facilities limitations. The effect of this is that much potentially important AIDS research is either deferred, not done at all, or not done as rapidly or as well as it might be done.

MICHIGAN STATE UNIVERSITY

Modern molecular biology is becoming a powerful tool in basic animal sciences. Our facilities are so primitive in this department that two young faculty have lost much time trying to set up laboratories that will sustain their competitiveness.

Our departments of Microbiology and Public Health, Anatomy and Physiology are in obsolete buildings handicapping both the quality of research and the size of the graduate student and postdoctoral enrollments we can accommodate.

NEW YORK UNIVERSITY

In our Biology Department, a number of research efforts are hampered by inadequate facilities. In some areas of biological research, investigations are hampered by the lack of up-to-date central facilities, including a DNA sequencer and synthesis facility, and a spectro-fluorimeter. In plant molecular biology and plant systematic biology, greenhouses are an essential facility; in the absence of a modern greenhouse, our biology investigators are unable to pursue research in this area.

UNIVERSITY OF CALIFORNIA

Less than 50% of the available research space is "suitable for use in the most highly developed and scientifically sophisticated research in its field," according to input provided by S/E units. Research is most upgraded with institutional funds in connection with recruitment and retention of faculty. Little upgrading can be accomplished through research grant funding. We need augmented funding levels to expand our program of renovations to include the utility and service infrastructure within buildings. One of our middle-size bioscience units (not included in the three-phase bioscience space upgrading) has described the departmental situation as follows:

Controlled Temperature and Clean Air In Laboratories (Highest Priority)

Controlled temperature in our laboratories is now even more important than in the past. Modern research instruments such as our recently acquired Fourier-transform infrared (FTIR) and inductively coupled plasma (ICP) spectrographs require environments with very limited temperature range to perform optimally. Although air conditioning is rarely needed for comfort in Berkeley, these instruments with their highly precise optical systems and associated computers do require it. Studies of soil water transport, water extraction, measurement of soil water potential, soil rheology and soil microbiology all require controlled temperature environments. The department presently has only one very small constant temperature room to accommodate these activities, and this facility has a history of being inoperative for very long periods (over 1 year in one episode), apparently because of the difficulty in obtaining parts for an obsolete system.

The air blown into labs and offices by the Hilgard ventilation system is extremely dirty. Improvised filters put over outlets are inefficient expedients. They are overloaded with particles in a short time. The fiberglass filter over the air outlet above the computer where I am now sitting has reached "breakthrough" in less than four weeks.

Fume Hoods with Acid Traps (Very high priority)

Digestion of soil and plant materials requires strong reagents and high temperature. At present there is only one hood in the department with a perchloric acid trap and which is equipped with scrubbers to remove nitric acid fumes. The provisions for trapping the potentially explosive perchloric acid and corrosive nitric acid fumes were improvised with department resources. While this one arrangement is effective, it is clearly inadequate for the department's needs. All department laboratories doing wet chemistry should have hoods with acid filters/traps for safety, environmental protection and preservation of the ducts.

UNIVERSITY OF CALIFORNIA - LOS ANGELES

Studies in basic and applied molecular biology in relationship to developments in biotechnology are being impaired by the lack of modern facilities. Such facilities require special fermentation facilities, special environmentally controlled areas and the modern laboratory systems that meet the regulatory requirements that have been recently promulgated in this area.

THE UNIVERSITY OF IOWA

Outdated facilities are impacting adversely on the University of Iowa's undergraduate and graduate education programs. For example, in biology, as intensive laboratory training in molecular techniques is required for large numbers of undergraduate students, classroom laboratory space once used only for desktop experiments must be remodeled and rewired to handle multiple centrifuges, power packs, refrigerators, personal computers, tissue culture and chemical hoods. The problem is repeated in each of the University's science and engineering departments for which a myriad of automated and electronic equipment is essential for basic undergraduate laboratory instruction.

The eventual proof of the biologic process is the living animal. As our knowledge increase, so the effects of the various agents and insults are becoming clearer and the demand for clean, pathogen-free animal space is increasing. Added to this is the provision for transgenic animals, in which the ultimate test of the new DNA-technology is conducted.

Researchers in our biomedical area, particularly in our internationally renowned cardiovascular research center, must presently delay or forgo studies utilizing dogs and primates because of the current limited capacity of existing facilities. Proposed U.S. Department of Agriculture regulations will require a doubling of space for housing and exercise of dogs and primates. In addition, there is a critical need to develop special facilities for the use of transgenic mice, containment of pregnant sheep, and improved and expanded aseptic surgical research facilities. These are all examples of the important needs to improve the infrastructure for health related studies. It is estimated that the University of Iowa will need to invest $6.4 million in improvement and expansion of animal facilities to comply with regulations and to meet the expanding biomedical research needs. This investment is in addition to $6 million that has been spent by the University since 1979 to bring the University into compliance with USDA regulations and PHS guidelines.

UNIVERSITY OF MARYLAND

On our campus, some of the buildings have air conditioning powered by steam; this arrangement results in shut-downs for the cleaning of the equipment and in outages, when power is interrupted. This antiquated set-up adversely affects research endeavors in biochemistry and in the animal sciences.

Our microbiology program was housed for years in an antiquated building with make-shift arrangements for new research requirements. Clearly, the inadequacy of the facilities prevented the department from beginning serious work in certain new biotechnology areas.

UNIVERSITY OF MINNESOTA

Antiquated animal research facilities are blocking research using appropriate animal models in biomedical fields, in modern work on livestock production, and in investigations of certain animal diseases in veterinary medicine. Moreover, in the biological sciences, work on the genetic engineering of fish and other aspects of basic fish biology is impeded by lack of good space to rear and maintain the fish. Recently some makeshift facilities malfunctioned and we lost some very important specimens, setting back our work significantly. Also in the biological and agricultural sciences, greenhouse space for basic studies in plants is completely inadequate. Two of our "research" greenhouses are deteriorated so badly that they cannot be renovated; we are critically concerned that this not be allowed to happen to the others which now badly need renovation. Our plant sciences research is greatly impeded by this problem. Often the next logical experiment simply cannot be done due to lack of facilities.

In many of our research programs in psychology, in the social sciences, in the biological sciences, the physical sciences, and in the biomedical sciences we have had to resort to renting space in the community. This allows us to acquire space that is adequate to support the research function, but it impedes the development of the research program because it isolates people from others with whom they should be interacting. This has become a critical problem for us in some programs.

UNIVERSITY OF PITTSBURGH

Obsolete X-ray crystallography facilities and equipment in our Departments of Biological Sciences and Crystallography, and in our medical school's basic science departments constrain and impede various research projects on protein structure being conducted at our University.

Our Departments of Biological Sciences and Behavioral Neuroscience are in need of a central animal housing facility and state-of-the-art tissue laboratories in order better to capitalize on the talents of their faculties and graduate students.

UNIVERSITY OF SOUTHERN CALIFORNIA

All of the Department of Biological Sciences portions of Geological Sciences and Chemistry are housed in the buildings listed above and the research and educational programs offered by these departments is being adversely affected by the inadequate and/or obsolete facilities. A few examples:

In Marine Biology we are trying to expand an exciting research effort which combines biochemical, microbiological and molecular techniques in the study of the early developmental stages of invertebrate organisms. In addition to basic science, the work has significant application in biotechnology and agriculture. However, the research is being severely hampered by obsolete facilities. All of the laboratory bench-tops are coated wood and unusable or incompatible with the use of chemicals, stains, and radioisotope tracers routinely used by the faculty and graduate students. (Chemical hoods in the building no longer meet code requirements for many acids are highly volatile or toxic substances.) The laboratories are not air-conditioned and become unbearably warm in summer months, to the inconvenience of researchers and the detriment of computers and electronics. Expansion of the program can only be done as labs in the building are renovated at considerable time and expense. The Molecular Biology program is housed in buildings now more than 25 years old and in need of extensive renovation of the hood ducting, air supply system, benching and countertops (which contain an asbestos impregnated epoxy) and laboratory layout. The lack of adequate laboratory facilities is adversely affecting the development of this very important component of the Biological Sciences. Without well-equipped, modern facilities, the Section is at a disadvantage in the recruitment of both junior and senior level faculty. The program has critical deficiencies in the areas of molecular, cellular and developmental biology, and we are trying to fill this need by building research efforts in gene control during development, cellular growth controls and communication between cells and signal transduction. However, these efforts are limited by the poor quality of the existing research space and, again, extensive renovation must occur before we can proceed.

THE UNIVERSITY OF TEXAS AT AUSTIN

Molecular Biology: Life sciences at UT reside in the traditional departments of Botany, Microbiology, and Zoology and in the Divisions of Biochemistry and Nutrition. The life sciences, biochemistry, and nutrition groups have, over the past 10 years, attempted to develop programs in molecular biology. The major problem has been recruiting new faculty in the absence of modern facilities to support molecular biology research. The Department of Botany, with a #1 ranking nationally, is housed in a building constructed in 1932, and the Department of Microbiology and approximately half of the faculty in the Division of Biochemistry are housed in a building constructed in 1954. The Division of Nutrition is housed in a building that does not have the support facilities for modern wet-bench research. The Botany building does not have the support facilities for modern research, nor is it feasible to renovate the building to conduct modern molecular biology research. The building that houses the Department of Microbiology and some of the biochemists can be renovated to support molecular biology research; however, the estimated cost for renovation is $16 million. The Department of Zoology (ranked #7 nationally) is housed in a building constructed in 1968. Although this building is suitable for molecular biology research, there is need for substantial renovation for existing faculty as well as for new faculty.

Molecular biology development at UT has the highest priority. Approximately $65-$75 million is required to construct new facilities for molecular biology and to renovate existing buildings for life sciences and biochemistry. Current plans are to construct a new molecular biology building at an estimated cost of $25 million; however, this will not address the renovation needs of the existing life science departments and the Division of Biochemistry. The consequences of obsolete space for the life sciences are that the nationally ranked programs will decline in quality; faculty will leave and recruitment of the best faculty will not be possible.

Many scientists on our campus have the capacity to contribute to the human genome project but lack the necessary equipment, modern laboratory facilities, and automated instruments (such as an automated DNA sequencer and robotics) to compete successfully with other laboratories in the world.

The revolution created by recent developments in molecular biology will permanently change biology, agriculture, and medicine. Given our lack of state-of-the-art molecular biology research facilities, however, we are not in a position at the present time to be a major research force in this field. Other universities are in similar circumstances, making our overall national effort weaker than many existing programs in Japan and Europe.

YALE UNIVERSITY

Deteriorating and obsolete greenhouses inhibit ongoing research in plant molecular biology, an investigation important to our understanding of plant genetics as well as to advances in practical agriculture.

In cell biology, an imperfectly functioning temperature control ended a fifteen-year-old experiment by destroying a genetic stock collection of fruit flies. Although valuable results had been obtained from the experiment, its premature termination required additional expenditures and a three-year delay to partially replicate lost materials.

Chemistry

CARNEGIE MELLON UNIVERSITY

The major place in which we have had an adverse effect is in the teaching of chemistry. We have a brilliant new idea for education that will increase the number of majors in both high school and college for chemistry. Unfortunately, in order to implement our ideas, we need a modern facility. We also have some original ideas on ways in which new laboratories should be constructed. We are trying to raise $7 million to proceed with this project. In the meantime, the idea is languishing, and we are not doing as good a job as we could for the education of chemists.

The chemical industry is worrying about the future supply of chemists, because this area is no longer drawing the numbers of students at either the undergraduate or graduate level that are needed by the industry. Obviously, this industry remains an important one for the United States.

CASE WESTERN UNIVERSITY

In the area of polymers, laboratory facilities for structural analysis do not require heavy wet chemistry facilities and related mechanical support systems. Cutting edge research in this area has now moved to synthesis and/or creation of polymers such that new wet chemistry facilities are required. Provided for increased air changes in a new laboratory located in a 1950's building, with limited mechanical capabilities, is very difficult. Achieving full research activity potential and maintaining safe environmental conditions and also very difficult.

THE CATHOLIC UNIVERSITY OF AMERICA

The overall chemistry program will require two large pieces of equipment to determine structure of complex and molecules: a hi-field NMR spectrometer for work in Biochemistry and a hi-resolution mass spectrometer for research in Organic chemistry. It will be impossible for CUA to compete in research involving molecular structure without these equipments. Each system will cost at least $500,000. CUA does not have the ability to purchase large equipment in this price range, nor is it in a position to do so even if a 50%-50% cost sharing is required.

COLORADO STATE UNIVERSITY

The Chemistry Building is an example of the pending needs on this campus. Storage space for chemicals and supplies is grossly inadequate. Supplies are stored in cabinets in hallways, thus exposing students and faculty to potential problems. Disposal of chemicals is borderline at best, according to current standards. Equipment in many cases has been given the "bandaid" fix, and requires daily tinkering to keep it operational. Library and study space in the building are grossly inadequate; classrooms are overcrowded.

Another negative effect of the facilities problem in the Department of Chemistry is the University's ability to retain outstanding faculty and attract reputable new faculty. In both retention and hiring situations, we are told by the faculty that we would fare better in this competitive arena if better facilities existed. Typically, we can cope with the salary demands of the faculty. It is the need for facility upgrade and/or replacement that is most difficult to accommodate.

IOWA STATE UNIVERSITY

At Iowa State University we do have programs that are severely affected by obsolete research facilities. In chemistry, traditionally one of the strongest programs at Iowa State University, we are in the midst of a major renovation project of our core chemistry facility. Our present facility of more than 200,000 square feet houses more than 30 chemistry research groups. Unfortunately, our chemistry research groups are concentrated in areas of traditional strength at Iowa State (materials, sciences, organic chemistry, etc.) and because they occupy all present space we are limited in our ability to grow chemistry research activities into new areas where interdisciplinary research is required. For instance, we have a strong interest in developing a natural systems chemistry program that will support and enhance our movement into fundamental agricultural research. To do this we need facilities and equipment on a relatively major scale. We are unable to provide such facilities or equipment, in spite of massive state investment, and as a result we feel that certain new knowledge producing environments will not be created, and as a result certain critical knowledge may not come about. It's important to remember that it's not as if we can eliminate our existing chemistry program, which is successful both in terms of research and in terms of teaching, to move into new areas because we cannot. We have developed ongoing streams of knowledge and student production that justify their continuation. But now to move into broader and more interdisciplinary programs linking chemistry with other activities on the campus we find that we are severely facilities and equipment limited. In our opinion this does result in an impedance of the research enterprise.

THE JOHNS HOPKINS UNIVERSITY

Molecular and atomic chemistry research at Hopkins is hampered by lack of adequate facilities to house modern equipment, such as state-of-the art NMR and X-ray diffraction instruments. This situation is compounded by the difficulties in computer/information networks and similar systems. This adversely affects research involving, for example, DNA chemistry, polymers, and advanced materials, each of which is a critical area of technology for the nation.

UNIVERSITY OF PITTSBURGH

Very recently, one of our senior organic chemists who pioneered the field of molecular recognition, a field of widespread interest and application, left the University for another institution because we were unable to provide him with adequate research facilities and state-of-the-art equipment needed to establish an Institute for Molecular Recognition.

UNIVERSITY OF ROCHESTER

Funding was recently received for an NSF Science and Technology Center in Chemistry: in order to house the Center, major renovation, $900,000 of costs, must be done in an existing building. Only $250,000 of that cost was funded by the grant; the institution must bear the rest of the cost.

UNIVERSITY OF SOUTHERN CALIFORNIA

There are a number of exciting new research opportunities in organic and organic-metallic chemistry which the faculty of Chemistry would like to exploit but find themselves handicapped by the aging and inadequate laboratory facilities available. Although a few of the laboratories have recently been improved, the majority of the hoods, ducting and air supply system is substandard and in some cases no longer meets code requirements. The problems related to laboratory facilities are not only restricting the expansion of existing research programs, they are increasingly becoming a major hindrance in the recruitment of replacement and new faculty. At the present time we are losing one junior professor because of problems related to the research space.

UNIVERSITY OF TEXAS AT AUSTIN

Some of our programs in organic, inorganic, and physical chemistry are being impeded because of the facilities in which they are being conducted. The laboratories were constructed in the early 1960s and are not equipped and configured to support modern research in these areas. Their renovation is sorely needed to address issues of safety and research productivity. For example, some experimentation currently must be moved to a different area of the building where hoods and other laboratory facilities can support the work to be done. This is particularly true of materials science research in which highly toxic and dangerous materials are under investigation.

UNIVERSITY OF WASHINGTON

In January 1988 the University of Washington retained two prestigious architectural firms, the NBBJ Group and TRA Associates, to study its science and engineering facilities. Among the conclusions reported by this study are the following:

The need for additional space for science and engineering at the University of Washington in the next 15 years totals 527,000 assignable square ft. (ASF) under a "no growth scenario", or 867,000 ASF under a "modest growth scenario". These numbers correspond to an increase of 32% and 52%, respectively.

The physics building was described as follows: "Physics Hall, built in 1928, is the main physics laboratory and teaching facility at the University of Washington. It is unfit for the conduct of modern science. It lacks the capability to accommodate heavy equipment in laboratories and would require major structural improvements to handle additional floor loads and meet seismic standards. Other problems pose threat to the safety of its occupants; unenclosed exit stairs would act as chimneys in event of a fire; adequate electrical power is not available in many laboratories; and some labs illegally vent into corridors." Bagley Hall, the building which houses the Department of Chemistry, is, in general, in worse condition than the physics building.

Engineering

BROWN UNIVERSITY

Our engineering and physics building is over 20 years old and can not accommodate any expansions into new topical area, e.g. thin films, robotics, and laser applications.

THE CATHOLIC UNIVERSITY OF AMERICA

In the School of Engineering, it is desired to expand a strong and well-supported program in underwater acoustics by the U.S. Navy to a much needed area of architectural acoustics. The present sponsor is not interested in this expansion and the University is in no position to provide the one million dollars necessary to provided the equipment to initiate the program. Were the facilities developed, there is no doubt that it would attract ready sponsorship. Similarly, modest programs in robotics and active control of structures can only be fully developed with the infusion of equipment monies of similar magnitude.

CORNELL UNIVERSITY

An example of a major program at Cornell University which is adversely affected by obsolete research laboratories is the School of Electrical Engineering. This school occupies a building which was built in the mid-1950's in order to house a planned, much larger program in undergraduate education. The planning did not include any element of research facilities. Over the past 30 years the School of Engineering has evolved into one of the leading research departments in its field in the United States. The research function, including office space for graduate students, postdoctorals, research associates, shops and research laboratories was shoe-horned into the existing building, or, in some cases, laboratories were placed in off-campus locations or in other buildings. As research and instructional pressures mounted due to the increased student interest in electrical engineering, space devoted to instruction shrank. One consequence was the reduction of the required junior-year laboratory course from five hours per week in the laboratory to three hours per week. This allowed twice as many laboratory sections to be taught. Instructional material was taken out of the course in order to complete it in three hours instead of the five previous. Subsequently, the two-semester sequence was reduced to a single semester and additional teaching laboratories which were used for specialized senior-level courses were merged or eliminated. The research laboratories, being placed in former classrooms, instructional laboratories, offices, and so forth are totally inadequate. They generally have no humidity control, no air conditioning, and so forth, which makes use of electronic equipment difficult on hot days. Research space per faculty member in the school is less than 500 square feet, and compared to about 2000 square feet in comparable departments. As a consequence, the magnitude and quality of research and the quality of undergraduate instruction which is done in this school, an area vital to national competitiveness, is severely limited by inadequate space.

As a consequence of this situation and similar pressures in other departments in the engineering college, the college prepared a master plan for meeting space needs. The first element of this master plan was to have been construction of a laboratory building for the School of Electrical Engineering. Because of immediate time pressures to house the new supercomputing facility, the college's space needs were placed second in priority. Even though the college master plan was created three years ago, it now appears that it will be at least five to ten years before resources can be found to begin construction on a laboratory building for electrical engineering. In this school, the space pressures on both teaching and research will therefore have spanned the entire professional careers of a generation of faculty members.

A third area of need is closely related to the microelectronics area of the School of Electrical Engineering. The university is currently trying to organize joint university/corporation efforts for research on optoelectronics, electronic packaging, production of semiconductor devices, and advanced lithography. Those strategic liaisons with corporations envision environment which will contain both open research by university people and collaborative research conducted by employees of several different corporations. Corporations might also be able to rent space in an adjacent facility to do their own proprietary work. In this particular case, it may be feasible to pay for the needed space by the program revenues, although it will be a substantial challenge to provide this space on the required time schedule (about 18 months). If we are unable to provide this space, the chance for major industrial collaborations which could affect the national competitive picture in these important areas will be severely compromised.

MICHIGAN STATE UNIVERSITY

In engineering we have been so short of laboratory space we were unable to recruit faculty with active research programs. We purchased a commercial facility several miles from the campus and adapted it to serve as a turbulence laboratory. We built a temporary structure of 66,000 square feet about one mile from the Engineering Building in which to develop laboratories and finally we have received state bonding funds to double the size of the present Engineering Building. When this addition is completed in late fall of 1989 we will begin renovation of the old wing. This should be completed in 1991, but the total facility will not provide all the Engineering departments with research space needed.

MISSISSIPPI STATE UNIVERSITY

Aerospace Engineering - education programs are adversely affected because of restricted instructional laboratories, lack of faculty office's, and inadequate air conditioning resulting in excessive computer down-time. The problem of asbestos removal must be addressed (this is true for many buildings, instructional, research, and administration - across campus). Some research, faculty, and instructional space will become available when new construction is completed in the Research Park complex; however, this space cannot be effectively utilized unless and until a fully working computer networking system is in place.

The department's Raspet Flight Laboratory, located some miles away from the campus, was built in the early 60's. Continuing renovation is required to keep this aging facility operative. As the university's aerospace research programs increase, the available space in the nearly 40-year old facility becomes more cramped and less efficient.

The Diagnostic Instrumentation Analysis Laboratory (DIAL) develops advanced optical instrumentation systems for use in fossil energy technologies and in manufacturing and industrial processes. Its laboratories are scattered through four buildings, necessitating dismantling of equipment in one laboratory, transport to the test stand facility, and reassembly for testing. The process then must be repeated to return the instrumentation to the developmental laboratory. DIAL research interests included the development of intrusive probes and sensors for diagnostic use in MHD or similar facilities, and extension of the capabilities of the Laser Doppler Velocimeter System (which measures particle velocity along a plane) and development of a 3-D system. Such extension of research requires additional appropriate space in a research facility designed for this type of research.

RUTGERS UNIVERSITY

[E]ngineering research and graduate education at Rutgers have only recently received strong State support. They are developing rapidly in response to imperative regional needs, exploiting evident opportunities created by the exceptional quality of corporate engineering research. Availability of departmental research facilities determines the pace at which these developments can proceed.

UNIVERSITY OF BUFFALO:

In all areas of engineering, including materials, manufacturing engineering, biomedical and biochemical engineering, and engineering instruction, new technology is developing so rapidly that it is impossible for the Engineering School to have available the latest hardware and, in the cases where computing is part of the program, the latest software.

As a specific example, the materials research programs offered through our Departments of Chemical, Electrical, and Mechanical Engineering face the following:

Our high resolution microscopy and analytical facilities, which must support the materials efforts, are wholly inadequate. We have faculty with the talent but our research laboratories are either without the appropriate equipment (clean rooms, furnaces, CVD facilities, MBE, microscopes, etc.) or have an inadequate, technologically obsolete capability.

UNIVERSITY OF FLORIDA

An accurate estimate of the need for space to feed the department's rapid growth in research is thirty thousand square feet. There are many good reasons for this additional need for space, but the most compelling is that the department has hired ten new faculty in the last eighteen months, among them the college's first Eminent Scholar, Dr. Tang Sah. Dr. Sah occupies the Robert C. Pittman endowed chair. He is a leading researcher in semiconductor electronics. In the 1950's he worked with William Shockley, Nobel Laureate and co-inventor of the transistor, as a senior member of the technical staff of the Shockley Transistor Corp. In 1959, Sah became head of the physics department at Fairchild Semiconductor Corp., leading a group that developed the first stable MOS transistors. His work pioneered the technology that made possible the first digital watches. He continues to make major contributions as is evident by his receiving the Jack Morton Award from IEEE this year. We have attracted Dr. Sah to the University, but are now unable to meet his space needs. His group alone will secure over $1,250,000 in research funding next year. The work is largely experimental and requires significant amounts of high-quality (like clean rooms) space. To quote Dr. Sah's closest colleague, Dr. Fred Lindholm:

"1. We cannot get the experimental stations set up in which to do our research.
2. We cannot add the graduate students coming this fall who need to use these work stations.
3. We cannot add postdocs we need to help us do this research and to assist in educating our graduate students.
4. We cannot have the use of Professor Sah's reprint files or his journals.

Accordingly, our research and education via research is severely compromised, and our ability to bring in substantive research funding to provide for graduate student education and the maturation of our junior faculty associates is severely limited."

This is not a new problem. After being with us for less than eighteen months, Dr. Luis Figueroa, a well-known expert in laser technology, resigned in June of 1987 because of inadequate facilities. In his letter of resignation he states, "When I was hired, I naively assumed I would get space to build a semiconductor laser characterization lab to support my research. I was mistaken! If I would have known about the magnitude of the space crisis before I was hired, I would have either negotiated using different methods or found a better arrangement elsewhere."

UNIVERSITY OF ILLINOIS

In Mechanical Engineering the space is very open and not usable for modern instrumentation. It has been necessary to divide up floor space with wire cages and put laser equipment inside the caged areas. The lasers are used in the diagnostics of combustion and fluid flows. There is no computer control of the engines. The control devised were built in the 20's and 30's.

In wind-tunnel-like experiments, there is a need to go to three dimensional studies and to scale up devices by 400-800%. This would require large-capacity vacuum and high-pressure air sources, which are not available.

A proposed center for the study of refrigeration that involves industry-university cooperation lacks the space and environmental controls to conduct the studies properly. A major activity involves the replacement of CFCs, and the substitute materials are so exotic that leak detection is difficult and there are no known sealing materials. Tribology studies with these materials are needed but there are no facilities in which to conduct these studies.

Across the engineering departments in general, only 29% of the research space is considered suitable for use in the most highly developed and scientifically sophisticated research in the field. In the physical sciences this number is higher (49%), but in the environmental sciences the corresponding percentage is only 8%.

UNIVERSITY OF PITTSBURGH

X-ray diffraction facilities and equipment in the Department of Materials Science and Engineering are 15 - 20 years old, and thus state-of-the-art research on polymers just cannot be done using them; our faculty who need state-of-the-art X-ray diffraction facilities and equipment must go elsewhere to do their X-ray diffraction work.

Moreover, due to inadequate space and lack of equipment, our School of Engineering is unable to establish a cell biology laboratory that is needed for the School's developing research and graduate training program in bioengineering.

The building that houses our School of Engineering was designed in the late 1960s and completed in 1972. At that time, the building's air conditioning was adequate relative to needs, but its air conditioning is today inadequate relative to current needs. As a consequence, each time a new laboratory is set up, a separate air conditioning system must be added at a cost of approximately $20,000. The cost to upgrade the building's central system is approximately $350,000 to $400,000. Obviously, given finite University and School of Engineering resources, funds used for air conditioning additions or upgrades cannot then be otherwise used in support of the Schools' research, training, and service activities.

UNIVERSITY OF SOUTHERN CALIFORNIA

Photonics/Optical Computing research is greatly hampered by the lack of adequate laboratory space. The materials processing side in particular requires very extensive (and expensive) facilities. This is an extremely important new technology that could lead to the so-called "sixth generation" computers.

We have millions of dollars of government research support including a U.R.I. in this area, and have one of the top two or three research groups in the country. The potential impact of their research and the necessary technology transfer will be compromised if new facilities are not created.

Manufacturing is another vastly under spaced and under-equipped area. We have major government and industry support through our Institute for Manufacturing and Automation Research (IMAR), but no real facility in which to conduct meaningful research.

The Division of Natural Science and Mathematics occupies five buildings in which the laboratory research facilities are obsolete or substandard, and a sixth in which the facilities are marginal. Only two buildings in the Sciences have adequate research facilities. The worst cases are buildings more than 50 years old, in which there are acute problems with the electrical services, hoods and venting system, plumbing, benching, heating and air conditioning systems and general design of the laboratories. To varying degrees, all of the subpart buildings share these problems.

UNIVERSITY OF TEXAS-AUSTIN

The Department of Aerospace Engineering and Engineering Mechanics research and education programs in guidance and control are affected by the inability of the guidance and control group to pursue a broad range of research activities because of the nonexistence of a controls research laboratory facility. Two areas of fundamental research for the future are fault-tolerant flight control systems and the development of new and sophisticated sensors and actuators. While our current research is primarily analytical and computational in nature, our capabilities would be greatly enhanced by including hardware in our future research activities.

Both of the research areas mentioned above are considered of primary importance to the future of U.S. aerospace industries. In addition, our students would be more effective in these developments if they had a better understanding of computers, sensors, and actuators and their use in sophisticated flight control systems.

The Department of Aerospace engineering and Engineering Mechanics has no facilities for high temperature work on metals, metal matrix composites and ceramics, nor does it have adequate facilities for the study of fiber/epoxy types of composites. It has no facilities for evaluating the mechanical characteristics of brittle materials such as ceramics.

The internationally recognized Structural Engineering Laboratory research and teaching program is threatened by an aging physical plant and facilities that are not adequate to support current or anticipated research efforts. For example, a 25-ton overhead crane has hazardous exposed electrical rails, worn-out brakes, antiquated controls, and other safety problems, the original electrical distribution system unsatisfactory, providing insufficient electrical power for equipment now in the lab and on order; roof and wall problems, rainwater, dust, and temperature changes endanger equipment and research projects, rotting, damaged, and worn-out doors provide no security; there is insufficient air conditioned laboratory equipment; and there is an acute shortage of faculty, staff, and student office and work space.

UNIVERSITY OF VIRGINIA

Externally funded research at the University of Virginia is growing currently at an annual rate of 15%. Such growth cannot continue because we have already saturated our research space.

In the School of Engineering and Applied Science, a major grant from the Department of Transportation supporting experimental crash impact research is being severely impeded by the unavailability of suitable research space. In addition, the space available for the support of academic computing is ridiculously inadequate.

VANDERBILT UNIVERSITY

Vanderbilt currently has sufficient space for most work, with the exception of our Engineering School. One recent inventory shows that the Engineering School needs over 67,000 net assignable square feet - 57,440 of which is need R&D space. This shortage is critical, as illustrated by the case of laser equipment on campus: because of space constraints, the Engineering School has unused lasers in storage and the Physics Department has underused lasers -- all this after construction of a $2.6 M building for a free electron laser.

YALE UNIVERSITY

In chemical engineering, a faulty air handling system permitted humidity to build up and destroy a salt crystal operating as the beam splitter of an interferometer, causing research delays and several thousand dollars in additional costs to Yale.

Environmental Sciences

COLORADO STATE UNIVERSITY

The Natural Resource Ecology Laboratory represents an area of keen national and international interest. The lack of adequate space is acute in this department. Refrigerators sit in hallways. Students sit at chairs in hallways to study (very distracting and undesirable situation). This department has experienced extreme difficulty in retaining outstanding researchers due to the lack of adequate facilities and space.

These two departments are representative of the harm that can be caused to the quality of programs as the result of sub-par facilities. As stated previously, it is not only the quality of the research that suffers, but the quality of the educational programs as well.

CORNELL UNIVERSITY

Another example on the Cornell campus is the Center for Environmental Research. The staff of this center are currently dispersed among four different buildings on the campus. Substantial recent effort in this center has focused on questions related to global environmental change. There appear to be major opportunities for more interdisciplinary basic research to be conducted in this area, and funding for programs in the center has grown substantially over the past two or three years. This center needs about 15,000 square feet to consolidate its central operations in one place and provide a focus for expanding efforts on the global environment. The space needs include both offices and laboratories. No solution is on the horizon for meeting those space needs, even though a substantial fraction of the work of this center is in the statutory colleges of the university that are supported by the State of New York. Budget difficulties in the state, coupled with pressures for better teaching space in the biological sciences, make it unlikely that the state will be able to respond to such space needs for a period on the order of five years. Even though basic interdisciplinary research on global environmental effects is of vital importance to society, it is unlikely that programs of the required magnitude can be mounted within the space constraints of the institution. Graduate students will not be trained in sufficient numbers to meet national needs in the environmental area as a result of current shortfalls in research space.

UNIVERSITY OF KANSAS

Recently, society has begun to recognize that an ecological crisis exists. Species are being depleted at an enormous rate, especially in the American tropics. This realization is recent, even though professionals have been warning of the crisis for decades. The University of Kansas is one of a few universities that has maintained a concentration of talent in the area of natural history. We are moving, with similar institutions, to establish a program to inventory species diversity in threatened areas. Our efforts will be severely handicapped because we do not have adequate facilities for storage, analysis and curation of materials that will be obtained during these studies. We will have to solve this space problem before we can move forward.

UNIVERSITY OF WISCONSIN-MILWAUKEE

While some facilities modernization has occurred at the Center for Great Lakes Studies (due in large part to an extramural award of $500K which leveraged an additional $3 million), much more must be done to replace obsolete research instrumentation which is employed across various areas of research (aquatic, environmental science, engineering and in other disciplines). The Center is the major research facility on the Great Lakes and has the potential, with proper development, to work on the major problems of environmental health facing the Midwest and the nation.

Materials Sciences

CARNEGIE MELLON UNIVERSITY

In the research area, there is a major shortage of space for the accomplishment of large-scale research in areas such as robotics and advanced materials. We have been renovating a number of buildings, but we are still short of the space that we need. We have a series of original ideas on the handling of nuclear cleanups, and we need more space for constructing the robots that will be able to move into a nuclear plant or other hazardous areas to eliminate the risk to human beings. We are trying to find money and space to do this. In the meantime, the research is being held back. Similarly, research in electronic and other non-metallic materials is limited by space and equipment. We have a major national problem, and progress is being impeded by the lack of facilities. We are in grave danger of being unable to compete in the international arena in electronics and advanced materials.

STANFORD UNIVERSITY

Modern materials research involves building materials atom layer by atom layer. This work cannot be expanded because of the lack of a building to house the special equipment. Such equipment requires special facilities providing adequate vibration isolation and systems to handle the wide range of gases and liquids, some with highly hazardous or with unknown properties used in atomic-level artificially structured materials. The materials affected include high-temperature superconductors, high-speed transistors, new advanced lasers, and new lithographic techniques.

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Advanced Electronic Materials Processing program is not advancing as rapidly as it could if adequate space were available. If legislative funding for new space, which has been requested, is not forthcoming, this nationally competitive program may be in jeopardy.

UNIVERSITY OF PITTSBURGH

Inadequate research facilities and insufficient numbers of available scanning tunneling electron microscopes and ion microscopes, and the lack of a tandem accelerator for thin-film analysis are impeding our research and graduate programs in surface science and materials science and engineering.

UNIVERSITY OF TEXAS -AUSTIN

High-temperature materials in general, ceramics, and lightweight non-metal composite represent the way of the future in aeronautical, space, deep water, automotive, and energy production areas. Without substantial investment in suitable facilities and equipment for evaluating the mechanical behavior of materials for transfer to these applications, the State will not be able to compete in national or international arenas. This will definitely have adverse economic repercussions.

In microelectronics research, currently does not have the clean room facilities required for fabrication of small-geometry device structures. Our lithography equipment is inadequate for features below one micron. Moreover, we do not have adequate toxic gas handling facilities and safety equipment necessary for many semiconductor growth and processing requirements.

Physics

MICHIGAN STATE UNIVERSITY

Our Department of Physics, except for the nuclear physicists who use the new National Superconducting Cyclotron Laboratory, are very poorly housed and severely constrained in spite of the fact that solid-state physics is a key contributor to a state of Michigan priority area of material science.

UNIVERSITY OF CALIFORNIA - LOS ANGELES

Studies in high-energy and plasma physics are being impaired by the lack of high bay spaces and the infrastructure components (electrical and plumbing) required for medium and large-scale experiments. Facilities for such mesoscale experiments are becoming essential for advances in the physical sciences and engineering.

UNIVERSITY OF FLORIDA

Approximately two years ago the Department of Physics at the University of Florida decided not to recruit anyone with a speciality in experimental physics. All available lab space had been exhausted. Therefore, only theoretical physicists were recruited. Basically, experimental physics has come to a halt unless new space becomes available.

UNIVERSITY OF PITTSBURGH

Our Department of Physics and Astronomy is developing a program in condensed matter physics, but this effort is being severely hampered by deteriorated research facilities and obsolete equipment, deficiencies which cannot be remedied by the University due to budget constraints.

UNIVERSITY OF ROCHESTER:

The University's Laboratory for Laser Energetics will have a $40 million program to upgrade its high-power laser. Brick and mortar money is not available for the extensive modifications required for the new target chamber building. This unique national facility will be a "go-no go" kind of decision based on whether the University provides the building. Do we fund it from tuition? No! Do we fund it from endowment? No! Do we borrow at market rates (not tax-exempted bonds, for we are at the cap limitation) and pay back the funds on the government-allowed amortization basis? Not likely to find a 50-year loan! Do we fund from gifts? No, cannot get a private gift for government research. Will the State pay for the building? Doubtful! How do we fund this important research?

THE UNIVERSITY OF TEXAS AT AUSTIN

In the Department of Physics obsolete research equipment has adversely affected departmental teaching and research. For example, in order to machine large-flow chambers to the required precision, sophisticated machine tools are required. Yet, all of our large bed millers and vertical lathes are over 40 years old. Newer equipment which is numerically controlled would allow construction of chambers to study the onset of turbulence in large systems, but this research initiative has not been possible. As a second example, the current materials preparation facility in the Department of Physics contains preparation equipment and test equipment which is over 20 years old. Because of a lack of user facilities, our department was unable to pursue a research program in the study of the new superconducting materials. In addition, the lack of a new modern research facility for the study of ultra-small microelectronic structures has precluded possible participation by our Department of Physics in several joint university/industry research projects.

UNIVERSITY OF VIRGINIA

Externally funded research at the University of Virginia is growing currently at an annual rate of 15%. Such growth cannot be continued because we have already saturated our research space. In the College of Arts and Sciences, a group of approximately 6 research faculty in nuclear and high energy physics who generate more than $3M/year in external research support have nowhere to put the equipment which has been purchased with federal funds.

UNIVERSITY OF WASHINGTON:

In January 1988 the University of Washington retained two prestigious architectural firms, the NBBJ Group and TRA Associates, to study its science and engineering facilities. Among the conclusions reported by this study are the following:

The need for additional space for science and engineering at the University of Washington in the next 15 years totals 527,000 assignable square ft. (ASF) under a "no growth scenario" or 867,000 ASF under a "modest growth scenario." These numbers correspond to an increase of 32% and 52% respectively.

The physics building was described as follows: "Physics Hall, built in 1928, is the main physics laboratory and teaching facility at the University of Washington. It is unfit for the conduct of modern science. It lacks the capability to accommodate heavy equipment in laboratories and would require major structural improvements to handle additional floor loads and meet seismic standards. Other problems pose threats to the safety of its occupants; unenclosed exit stairs would act as chimneys in event of fire; adequate electrical power is not available in many laboratories; and some labs illegally vent into corridors." Bagley Hall, the building which houses the Department of Chemistry, is, in general, in worse condition than the physics building.

YALE UNIVERSITY

In physics, difficulties in maintaining the water impermeability of the envelope of a specific research building, has caused constant adjustment and realignment of equipment, creating both delays and frustration.

AAU

Association of American Universities

1989 AAU Resolution on Facilities Funding

The construction and renovation of modern facilities for research—and especially those for science and technology—are vital to the future well-being of our nation. These facilities are essential, not only to the quality of our education and research, but also to our industrial competitiveness and national security.

Even in an era of scarce resources, we are convinced that systematic federal investment in research facilities is an urgent priority. Just as the success of the U.S. research enterprise reflects the willingness of those involved to provide support to competing projects on the basis of their scientific merit and promise, so also we believe the nation is best served when proposals for research facilities are evaluated first by an open, competitive review of their scientific merit. To the extent that earmarking of federal funds for that purpose bypasses the review of projects on their merits, we shall continue to oppose it.

The AAU, while strongly supporting increased federal appropriations for educational and research facilities and programs, asks its member institutions, other universities and colleges, and legislators to refrain from requesting or supporting "earmarking" provisions in such appropriations for at least the five major federal research agencies (National Science Foundation, National Institutes of Health, National Aeronautics and Space Administration, Department of Defense, and Department of Energy).

By "earmarking" we mean appropriations that designate funding for research or educational programs or facilities for a specific institution without prior designation either from the agency concerned or from a competitive process in which proposals from various institutions are evaluated first in an open, competitive review of their merit.

Approved by mail ballot of the Membership, June 9, 1989

AAU STATEMENT ON RESEARCH FACILITIES

The construction and renovation of modern facilities for research—and especially those for science and technology—are vital to the future well-being of our nation. These facilities are essential, not only to the quality of our education and research, but also to our industrial competitiveness and national security.

Even in an era of scarce resources, we are convinced that systematic federal investment in research facilities is an urgent priority. Just as the success of the U.S. research enterprise reflects the willingness of those involved to provide support to competing projects on the basis of their scientific merit and promise, so also we believe the nation is best served when proposals for research facilities are evaluated first by an open, competitive review of their scientific merit.

The AAU recommends the following set of policies and proposes to pursue them in the period ahead:

(1) We urge full funding of the Academic Research Facilities Modernization Program enacted last year in the National Science Foundation Authorization Act. That program is a start toward a coherent policy on research facilities. It recognizes that important needs exist in a range of institutions, including undergraduate colleges, institutions with high minority enrollment, aspiring research universities, and those that are already research intensive. Moreover, it moves to meet those needs in ways that will assure the public that, within each category of need, the money spent will produce the optimum return in education and research.

(2) We urge that a research facilities modernization program be authorized in the National Institutes of Health and that other federal agencies which sponsor research assume a responsibility for the university research infrastructure on which they rely.

(3) We urge that other policies that inhibit capital investment in research be modified. Specifically, we urge that the outmoded treatment of facilities costs within the government's indirect cost policies be changed to reflect contemporary reality, and that the current limitation on tax-exempt bonding by private universities be removed.

(4) We urge support for the National Science Foundation's EPSCOR program, designed to help states that have been less successful in the competition for federal research funds to build the capacity for their universities to compete successfully. We further urge consideration by other agencies of carefully crafted programs toward the same end.

(5) Finally, we intend to urge the President's Advisor for Science and Technology to put high on the list of priorities the problems of capital investment in science and to seek a coordinated approach recognizing important national and regional interests and placing them in the context of the need to achieve the highest quality science and technology of which this country is capable.

To these ends, we will continue to work with Members of Congress and the Administration to find the best ways to enhance the nation's research and education base.

Approved by AAU membership
Washington, DC
April 18, 1989

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Association of American Universities

AAU RESOLUTION ON FUNDING FOR SCIENTIFIC RESEARCH FACILITIES

We have received the Langenberg Committee report and intend to discuss it further among ourselves and with other associations. While we have some concern with its first recommendation, we support its call for an immediate and sustained effort to bring the higher education community, the Congress, and the federal agencies into discussion to resolve the issues surrounding the federal funding of scientific research facilities. We intend to engage fully in those discussions in the hope that common ground can be found and the processes that do not best serve the long-term quality and capacity of U.S. science can be put behind us. In the meantime, however, we:

(1) Reaffirm our support for the following propositions:

  (a) Decisions about funding scientific research projects should be made on the best available judgments of the importance of their probable contributions to scientific theory and practice.

  (b) The current practice of earmarking scientific facilities construction on the basis of criteria unrelated to their scientific merit is not in the interests of either the nation or its institutions of higher education.

(2) Instruct the president of the AAU to rely on these propositions as the basis of his representations to the Congress on this policy issue.

(3) Agree to observe a moratorium on earmarked funding for scientific facilities while seeking, in cooperation with other higher education associations and the Congress, the creation of federal programs to assist the nation's colleges and universities in meeting their facilities needs for research.

April 16, 1987

AAU Association of American Universities

AAU STATEMENT ON DECISION MAKING IN FEDERAL FUNDING FOR RESEARCH FACILITIES

The Association of American Universities represents institutions whose faculties are deeply engaged in research. We share with many other institutions and individuals a commitment to advancing the quality of the nation's research effort. Since the vitality of this effort is closely linked to the soundness of decisions made about science by public bodies, it is both appropriate and important for the AAU to state its collective views about the ways in which those decisions are best made.

The United States has evolved an admirable but fragile system of awarding federal funds for research. In general, Congress appropriates funds for the support of broad categories of research. Subsequently, the administering federal agency issues guidelines for making applications in a manner that assures fair and open competition. Researchers then submit detailed proposals that are judged by experts, scientists chosen for their ability to make sound and careful judgments in the scientific area involved. This method maximizes the scientific return on the federal investment by assuring that awards are made on the scientific merit of the proposal and the professional merit of the proposer.

The same method governed most federal programs in support of scientific facilities when such programs existed. However, in the early 1970s, most federal government programs in support of the construction and renovation of research facilities ended. The subsequent decade-long failure to attend to the capital base of university science has led to a backlog of need that has hampered American science and placed great stress on the processes by which the government allocates scientific resources.

We believe that processes based on the informed peer judgments of other scientists need to be preserved and strengthened. We therefore urge scientists, leaders of America's universities, and Members of Congress to support the practice of awarding funds for the support of science on the basis of scientific merit, judged in an objective and informed manner. Further, we urge them to refrain from actions that would make scientific decisions a test of political influence rather than a judgment on the quality of the work to be done. These principles should apply in making decisions about scientific facilities as well as in awarding funds for research projects.

Finally, we urge officials of the national Administration and Members of Congress to deal promptly with the decay of the physical plant that houses much of the nation's basic research. S.1537, introduced by Senators Danforth and Eagleton, is a bipartisan effort to deal with this national priority and deserves strong and prompt support.

October 25, 1983
Reaffirmed on April 22, 1986

Council of Scientific Society Presidents

Public Policy Statement

August 1, 1985

SCIENTIFIC REVIEW OF FEDERAL SCIENCE PROJECTS

Recommendation

The Council of Scientific Society Presidents adopts the following recommendation of the National Science Board:

> The National Science Board "calls for a Conference on Academic Research Facilities among the interested parties, to be sponsored by the NSB, the National Academies, and the Office of Science and Technology Policy. The conference should be held as soon as possible, utilizing talent from the financial community, Congress, state governments, federal agencies, academic institutions and business to define the problem and propose solutions."

The Council also approves the principle that all scientific projects, whether for a specific research program or for the development or construction of a facility, should be evaluated by a merit review process by impartial experts before being funded by agencies of the Federal Government.

Discussion

Several instances have recently been reported in which educational institutions have attempted to secure funding for scientific facilities by appealing directly to Congress, thereby bypassing the customary merit-review process by independent scientists. Fifteen examples of this are given in Table II in the appendices to the report of the National Science Board Committee on Excellence in Science and Engineering. Our committee has noted that all these examples involve the construction or development of scientific facilities, not scientific research projects per se. No instances have been cited where proposals for scientific research programs, as contrasted with proposals for the development or construction of facilities, have bypassed the well-established peer review process..

Proposals for federal support for the construction or development of scientific facilities should be subjected to the traditional independent merit review in the same way that scientific research projects are reviewed. The peer review process has been very successful in the post-World War II period of U.S. scientific eminence. The country's scientists have devoted a great deal of time not only to the analysis and review of scientific proposals but also to service on countless technical advisory panels in various branches of the government. If these scientists lose confidence in the willingness of the government to take proper account of scientific advice, it may become more difficult to secure appropriate advice in the future.

At the same time, it should be recognized that the evaluation of proposals for the construction of scientific facilities requires consideration of additional factors than is the case with proposals for the support of specific research projects. The peer review process should certainly be a regular part of the total review process to evaluate the general competence and achievement of the scientific staff that will operate the facility and to review the science that is planned for the facility. But there are other questions here, such as the distribution of scientific facilities in various parts of the country, the issue of which areas of science are in greatest need of additional facilities, and the desirability of support for emerging centers of excellence. (Recall, for example, the creation and development of the University of California at La Jolla in recent times.) For some of these questions, internal agency reviews might be the appropriate process, a procedure that has been used to some extent with proposals for facilities in agricultural research. However, whatever additional considerations are taken into account, a peer review by independent scientists should be a basic component in the deliberations.

In the report of the National Science Board Committee on

Excellence in Science and Engineering, whose charge was very similar to that of our committee, Section C is entitled "Characterizing and Attacking the Facilities Problem." Following their brief analysis of this question, the NSB Committee proposes, in Recommendation 3 on page 5 of the report, that a conference be held to "define the problem and propose politically feasible solutions."

Conclusion

The Council of Scientific Society Presidents adopts the following recommendation of the National Science Board:

> The National Science Board "calls for a Conference on Academic Research Facilities among the interested parties, to be sponsored by the NSB, the National Academies, and the Office of Science and Technology Policy. The conference should be held as soon as possible, utilizing talent from the financial community, Congress, state governments, federal agencies, academic institutions and business to define the problem and propose solutions."

The Council also approves the principle that all scientific projects, whether for a specific research program or for the development or construction of a facility, should be evaluated by a merit review process by impartial experts before being funded by agencies of the Federal Government.

American
Association
for the Advancement of
Science

Resolution on Scientific Peer Review

Whereas the partnership between the government and the community of scientists is essential to the advancement of science, and

Whereas, without broadly based, consistent, critical, and professional evaluation of proposed expenditures for scientific work, there is a growing danger that the quality of research and education in science will be jeopardized,

Be it resolved that the Council of the AAAS reaffirm its commitment to the principle and practice of scientific peer review as indispensable to the allocation of public funds for the scientific enterprise.

Adopted by the AAAS Council,
May 30, 1985

American
Association
for the Advancement of
Science

Statement on the Federal Funding of Science

By the Board of Directors
American Association for the Advancement of Science
December 10, 1983

In the long-standing relationship between government and science in the United States, major responsibility for funding basic scientific research has settled upon the government partner. For its part, the scientific community has accepted primary responsibility for defining research needs and opportunities and providing assurance that public funds are allocated on a priority basis, through peer evaluation. For either partner to breach its responsibility carries serious risk to the solidarity of what has proved an extraordinarily effective partnership.

The Board of Directors of the American Association for the Advancement of Science is concerned that failures to adhere both in principle and in practice to criteria of scientific choice at all times will serve only to diminish public confidence in the peer review system as the basis for allocating national resources, with serious negative consequences for the integrity and advancement of science.

The American Physical Society

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STATEMENT OF THE APS COUNCIL

SCIENTIFIC REVIEW OF RESEARCH FACILITIES FUNDING

We deplore the inclusion in the federal budget of major scientific projects that have not been subjected to the normal process of proposal submission and expert review. The consequences go beyond the diversion of scarce resources from projects of higher priority. Institutions are increasingly persuaded that political maneuvering is more important than scientific justification in securing federal funds. Yet each year many worthy scientific projects must be abandoned or deferred for lack of funds. The developing pattern of funding major projects without subjecting them to impartial expert scrutiny diminishes science.

Quite clearly Congress is responsible for considering a variety of factors--such as geographic balance, economic need, and affirmative action--in allocating funds for major projects of any sort. We urge, however, that review by impartial scientific experts be an important consideration in any allocation of funds for research facilities.

January 20, 1985

The American Physical Society

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EDITOR-IN-CHIEF
DAVID LAZARUS
UNIVERSITY OF ILLINOIS

For consideration by the Panel on Public Affairs and the Council of the American Physical Society

Draft Resolution on Peer Review

September 19, 1984

Whereas funding for basic science is not sufficient to respond to all of the opportunities that confront the scientific community; and

Whereas many worthy scientific projects must therefore be abandoned or deferred; and

Whereas every such instance represents a technological risk for the United States; and

Whereas prominent scientists willingly devote much of their time and energy to direct proposal review and service on review panels;

Be it therefore resolved that the American Physical Society, through its elected Council, urges that the informed advice of impartial scientific experts be sought in establishing priorities for the allocation of limited federal research funds, and that all proposals for scientific research and research facilities be required to adhere to established procedures of submission and peer review.

FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

PEER REVIEW

WHEREAS the peer review system has served in an exemplary fashion to promote the progress of biological science in this country, and

WHEREAS federal support for research facilities through political decision-making rather than through peer review can be extremely disruptive of the orderly scientific process, be it

RESOLVED that public officials move promptly to make federal money available in a more systematic way, through peer review mechanisms, to upgrade the biomedical research facilities of this country, and be it further

RESOLVED that research scientists, research institutions, and public officials recognize the central need for open peer-reviewed competition for federal funds for research and research facilities, and refrain from circumventing the peer review process to achieve their goals.

May 23, 1984

AMERICAN COUNCIL ON EDUCATION
Office of the President

MEMORANDUM

TO: ACE Board of Directors

FROM: J. W. Peltason

SUBJECT: Proposed Statement on Federal Funding of Research and Instructional Facilities

DATE: January 9, 1984

Community concern has been generated by the recent attempts of several institutions to bypass the customary review process to obtain federal funding for research facilities. The Association of American Universities last fall issued a statement urging scientists, leaders of America's universities, and members of Congress "to support the practice of awarding funds...on the basis of scientific merit...(and) to refrain from actions that would make scientific decisions a test of political influence rather than a judgment on the quality of the work to be done."

Similar statements have been issued subsequently by the National Academy of Sciences, the National Association of State Universities and Land-Grant Colleges, and the American Association of State Colleges and Universities. The ACE Commission on Governmental Relations discussed this matter at its fall meeting, and recommended that the Board adopt the following statement:

"There is a pressing need for increased federal support for the rehabilitation of research and institutional facilities. Established procedures for these support programs involve a system of review to assure equitable consideration and the awarding of funds on the basis of merit.

"At a time when fiscal constraints have severely restricted many federal programs, it is especially important to sustain the process which assures systematic allocation of scarce resources. Therefore we call upon leaders of the academic community and members of Congress to reaffirm the principle of broadly representative review of project proposals in fair and open competition, so that funding decisions continue to represent the best interests of both higher education and the national welfare."

Adopted at the Board of
Directors meeting of
2/23/84

Ruth A. Abdouch
Executive Secretary
Board of Directors

National Association
of State Universities
and Land-Grant Colleges

Robert L. Clodius, President

STATEMENT ON FEDERAL FUNDING OF ACADEMIC FACILITIES

In recent years, federal funding of various higher education programs has decreased markedly. In particular, wholly inadequate resources for facilities have led some institutions to seek direct assistance from Congress. The outcome of such a process could be an irrational system of distribution based solely on political influence. In that regard, the National Association of State Universities and Land-Grant Colleges shares the concerns of the Association of American Universities, the National Academy of Sciences, and others, that this approach is unacceptable, in that it could diminish the capability of higher education to carry out its mission in education and research, and we urge Members of Congress and leaders of colleges and universities to refrain from this practice.

We further urge the Congress to fund Title VII of the Higher Education Act and similar programs in other agencies at reasonable levels, and to insure the systematic allocation of resources to satisfy pressing national concerns.

National Association of State
Universities and Land-Grant Colleges

November 14, 1983

NSB Statement on Bypassing Merit Review in the Funding of Academic Research Facilities

Recent efforts by educational institutions to secure funding by appealing directly to Congress and bypassing the merit based review system represent the wrong solution to a real and urgent problem. The problem of deteriorating university research facilities threatens the health of the Nation's science and engineering base. To generate better solutions, the parties involved should meet to plan new initiatives that support university research without threatening the established science and engineering priority setting process that has served so well to promote excellence.

In the past two years, fifteen universities have bypassed that process and secured over $100 million for construction of facilities by appealing directly to Congress. In a number of cases, the funds were diverted from other scientific activities that had been selected on the basis of their merit.

The National Science Board has examined the implications of this development for the excellence and productivity of U.S. science and engineering, which today is the strongest in the world. As the challenge to America's competitiveness in defense and industry grows, so too does the Nation's reliance on its science and engineering strength. Bypassing the normal standards of scientific excellence through merit review procedures in science and engineering research jeopardizes this strength.

The problem is not yet severe, but the precedent has been established; lobbyists sense a source of funds, and each new circumvention increases pressure on schools that have so far resisted the temptation to pursue the same course. The question facing American universities today is this: Will they retain responsibility for the excellence of U.S. science and engineering, or will they cede it to purely political processes. The choice is in the hands of the science and engineering community. The trend is in the wrong direction.

The circumventions of merit review are being triggered by a serious problem: At many universities, facilities are deteriorating. Until this problem is addressed, the erosion of merit review will continue. A concerted effort -- by universities themselves as well as state and Federal Government -- to attack the facilities problem must be launched. For this, universities will indeed have to exert their political influence. But that influence must be directed at a long-term solution, not at the short-term and ultimately self-defeating steps of the past two years.

Too much is at stake to continue on the present course. As university facilities deteriorate, U.S. science and engineering will lose its grip on world leadership. If universities respond to deteriorating facilities by circumventing merit review, the decline in U.S. leadership will accelerate, and excellence will deteriorate into mediocrity.

To address these issues and to launch actions to solve them, the National Science Board:

a) Will continue to press the scientific community for strict self-regulation. It urges all professional societies, associations, academies, industry researchers, faculty and principal investigators to act in concert and support the peer review system.

b) Will evaluate the comprehensive merit review process, as part of a continuing process of scrutiny and improvement and as a reflection of the need to reassert the importance of the merit review system. Based on the evaluation, changes and improvements will be made, if required.

c) Calls for a Conference on Academic Research Facilities among the interested parties, to be sponsored by the NSB, the National Academies, and the Office of Science and Technology Policy. The conference should be held as soon as possible, utilizing talent from the financial community, Congress, state goverrments, federal agencies, academic institutions and business to define the problem and propose solutions.

The Council of Graduate Schools in the United States

RESOLUTION NO. 1

RESOLUTION IN DECISION MAKING IN THE FEDERAL FUNDING FOR RESEARCH FACILITIES

WHEREAS the United States has evolved an admirable but fragile system of awarding federal funds for research, and,

WHEREAS this system is dependent upon fair and open competition responding to federal agency guidelines, and peer review judgment by experts in the scientific area to be studied, and,

WHEREAS this method of peer review has governed most federal programs in support of scientific facilities when and where such program exist, and,

WHEREAS most federal programs to support construction and renovation of research facilities have been ended through a shifting of federal priorities, and,

WHEREAS in the absence of such programs colleges and universities are suffering a gradual increasing erosion in their ability to support state-of-the-art research in all scientific fields, and,

WHEREAS CGS member institutions share with many other institutions and individuals a commitment to advancing the quality of the nation's research effort. The vitality of this effort is closely linked to the soundness of decisions made about scientific research by public bodies.

NOW THEREFORE BE IT RESOLVED that the Council of Graduate Schools supports the recently adopted AAU Statement on Decision Making in federal funding for research facilities. CGS urges the national Administration and members of Congress to support the practice of awarding funds for research or facilities on the basis of scientific merit judged in an objective manner. CGS would further urge support for new spending authorities to support research facilities to keep our nation's investment in academic research facilities from becoming out of date.

Passed at the CGS 23rd Annual Meeting 12/83

American Association of State Colleges and Universities One Dupont Circle/Suite 700/Washington, D.C. 20036 (202) 293-7070

NAME OF COMMITTEE: Committee on Science and Technology
CHAIR OF COMMITTEE: John Wright
NAME OF PRESENTER: John Wright
DATE: November 22, 1983 RESOLUTION #13

WHEREAS, The 358 member institutions of the American Association of State Colleges and Universities (AASCU) are committed to fostering scientific research beneficial to our nation,

WHEREAS, Federal funds for research projects and facilities are traditionally awarded on the basis of their scientific merit judged in a fair and open competition,

WHEREAS, An equitable process of peer review at Federal agencies must be the guiding force in the awarding of funds for new scientific facilities and research projects,

WHEREAS, Recent efforts by some institutions have bypassed this preferred peer review process,

WHEREAS, Other scientific and educational associations have urged the reversal of these recent actions and an adherence to peer review procedures in all future scientific funding, be it

RESOLVED, That the American Association of State Colleges and Universities (AASCU) join with these other groups in reaffirming the principle that funds for the support of science be awarded on the basis of "scientific merit, judged in an objective and informed manner" by a panel of peers, and be it further

RESOLVED, That we urge scientists, educators and members of Confress to "refrain from actions that would make scientific decisions a test of political influence rather than a judgment of quality of the work to be done." *

*AAU Statement on Decision Making in Federal Funding for Research Facilities, October 25, 1983.

NATIONAL ACADEMY OF SCIENCES
2101 Constitution Avenue Washington, D.C. 20418

STATEMENT OF THE COUNCIL

FEDERAL FUNDING FOR RESEARCH FACILITIES AND INSTRUMENTATION

In recent months, there have been a few instances in which federal funding decisions for major university scientific facilities have not been subject to an appropriate review process. Informed peer judgments on the scientific merits of specific proposals, in open competition, should be a central element in the awarding of all federal funds for science.

In the past, such objective systems of evaluation have met the needs of our country well, and have contributed to the scientific preeminence of the United States. In the long term, they also help to maintain the pluralism that is important to the productivity of American science and is characteristic of political decision making.

We urge that the academic community and public officials exercise vigilance to protect this informed evaluation and decision-making process in the awarding of funds, not only for the support of scientific research proposals, but also for major scientific facilities and instrumentation.

October 30, 1983

HIGHER EDUCATION ACT OF 1965

Title VII--Construction, Reconstruction, and Renovation of Academic Facilities

This authority was first established in the Higher Education Facilities Act of 1963 and was inserted in 1968 into the Higher Education Act of 1965. The general purposes of the Act are to: 1) economize in energy use, 2) meet handicapped and health and safety regulations, 3) permit the construction and renovation of research facilities, including libraries, and the acquisition of special research equipment, 4) enable institutions to meet enrollment increases, and 5) eliminate asbestos hazards.

For FY '81-'84, Part A is authorized at $100 million annually, Parts B and C at $80 million annually. The last general appropriations for Title VII were in FY '73.

Part A authorizes funds for undergraduate (and combined undergraduate-graduate) facilities; funds would be distributed to states on a student population-based formula.

Part B authorizes funds for graduate facilities; grants would be awarded to institutions based on the recommendations of an outside panel of "specialists...competent to evaluate such applications."

Part C authorizes loans, interest grants, and loan insurance; allocation is loosely defined by exclusion--eg., loans would not be granted when equally favorable loans could be secured elsewhere.

Some further comments on the three sections of Title VII follow.

Part A--Grants for the Construction, Reconstruction, and Renovation of Undergraduate Facilities

Funds would be allocated to states according to a formula based on the number to students enrolled in higher education institutions and the number of students in grades 9-12, with $100,000 set as a minimum for a given state. Each state wishing to compete for funds would have to establish a state agency that would devise a plan for assigning priorities to eligible projects within the state. The Federal share of a project could not exceed 50% of the cost. At least 24% of the funds appropriated for Part A would have to allocated to states for public community colleges and public technical institutes. Funds could be used for undergraduate and combined undergraduate and graduate facilities.

Part B--Grants for Construction, Reconstruction, and Renovation of Graduate Academic Facilities

Funds would be awarded directly to graduate institutions of higher education, but the total annual allocation to the institutions of a given state could not exceed 12.5% of the Part B appropriation. The amount of each Federal grant could not exceed 50% of the development cost of the project. In awarding the grants, the Secretary would "seek the advice and recommendations of a panel of specialists who are not regular full-time employees of the Federal Government and are competent to evaluate such applications."

Part C--Loans for Construction, Reconstruction, and Renovation of Academic Facilities

At least 20% of the development cost of the project must be from non-Federal sources, but few other constraints to loan access were imposed. Loans were to be repaid over 50 years at a rate at least 0.25% above the average annual rate for all US interest-bearing obligations or 4%, whichever is less. Part C also contains provisions for a revpvomg loan and insurance fund, annual interest grants, and academic facilities loan insurance.

Uses of Title VII

Apparently, the rationale for using a state allocation procedure for Part A was that there was concern over Federal involvement in higher education, and the states were seen as a buffer. Part B awarded grants directly to the institutions because graduate institutions were seen to be more national in scope.

For Part A, the extent to which funds were allocated on some sort of competitive, merit basis was strictly a function of internal state procedures, since the funds were apportioned to the states by formula constrained only by very broad criteria of applicability to the general purposes of Title VII. Since Part C provided loans and loan assistance--with apparently a creditable payback record, it contains few allocation constraints.

During the '60's, when Part B, Graduate Facilities, was receiving general appropriations, review panels were used and included site visits to evaluate proposals. According to an Ed Department bureaucrat who worked in the Title VII Division at that time, the panel evaluations reflected more merit than pork. Panelists were selected by the Department and reflected prevailing priorities, and attempts were made to see that every state received some funds; but on the whole, he believes that the procedure was reasonably objective.

Since the end of general appropriations in '73, however, Part B has been used as the authority to fund special interest projects. In 1978, the frequently cited appropriations to Georgetown and Tufts used a combination funds recovered from previously appropriated Part C loan funds and new appropriations under Part B authority to fund international center facilities. In 1983, the University of New Hampshire and Boston College received $15 million and $7.5 million under Part B authority, with Congress waiving the requirement for 12.5% cap to individual states, the requirement for non-Federal matching funds, and the requirement for outside panel review.

Several of the special appropriations this year were given Part B authority by lifting the zero funds cap placed on Title VII by the 1981 Reconciliation Act, using as a vehicle an amendment to Title III legislation.

Chairman NUNN. Thank you very much, Chancellor Wyatt.

We have this chart that shows us that of all the basic research funds awarded to universities by Federal agencies—I believe going back to fiscal 1985, but which is probably pretty representative—that DOD gets about 10.29 percent; NSF, National Science Foundation, 23.7 percent; Health and Human Services, 52; DOE, NASA and Agriculture a lesser amount.

My question is—is the earmarking going on in these other agencies as much as it has been in defense or more?

Dr. PRESS. I can't give you the exact figure, Senator Nunn.

Chairman NUNN. Just your sense of it.

Dr. PRESS. I would say that the other agencies also have a serious problem, as does Defense. I certainly know that the Department of Energy has that problem. The National Science Foundation does. I'm not sure about NASA. The National Institutes of Health to a certain extent. But the exact proportions are available. I just don't have them in my head.

Chairman NUNN. Chancellor Wyatt.

Mr. WYATT. Neither do I, but I agree with the statement that practically every agency is involved.

Chairman NUNN. What you are calling for is a broad application of this overall merit selection rather than simply applying it to DOD. Is that right, Chancellor Wyatt?

Mr. WYATT. That's correct. That is what I am proposing.

Chairman NUNN. This committee, of course, took the initiative last year. We did it on the floor, and we had quite a spirited debate on the issue. And I am sure it is going to be revisited this year.

The difficulty is with this committee. We have jurisdiction over the Department of Energy, but when you get into the health and you get into the national science areas, this committee doesn't have that jurisdiction. Of course, the ideal thing is if someone on the Appropriations Committee—and I think Chancellor Wyatt and I have discussed this—would take the lead since the Appropriations Committee has the umbrella over all this funding, at least in the appropriated stage.

I hope that we will find one of our enlightened colleagues there who will take this broader approach because truly if the trend keeps going as it is, you are going to have the authorizing committees decide that, well, if we can't beat them, we are going to join them. And you are going to see it spread. I thought, somewhat facetiously but not completely, that maybe what we ought to do is take each member of a certain committee and just give them a pot of money and say you designate it; put that in the bill. So, Senator Gore designates $10 million wherever he chooses and so forth and so on because that's about where we are heading, if we do not stop it and get back to some kind of system.

But, on the other hand, this frustration about the old-boy network is real. It goes deep. It goes to membership throughout the House and Senate, and we have to have a better procedure and a broader procedure that does indeed take into consideration the talents of institutions that have not historically been participating but who have the capability.

Dr. Press, looking at it overall, do you believe the defense research budget is properly distributed among the Nation's universities and colleges today?

Dr. PRESS. By and large I would say that in terms of the defense interests, and in terms of the previous testimony that you have heard, and the way they subject grant applications to competition, they are not doing a bad job.

I am concerned that what they define as basic research in recent years, say, in the 6.1 category, has been shifting more toward the applied end. As budgets become scarce, there is that need for shorter term returns, and that does concern me. And, of course, the earmarking is eroding their ability to work in these areas as well.

We also heard in the previous testimony that they are trying to help aspiring institutions reach a higher level of excellence, and that is worthy as well.

In answer to your previous question, it would also help if the administration submitted a facilities bill covering all of the agencies, calling for a national program which takes into account both the national competition in terms of excellence and a major commitment to help second tier universities achieve a higher level of excellence.

Chairman NUNN. You are talking about $1 billion a year.

Dr. PRESS. Yes, and I realize that the deficit is a major problem. If we had the bill, and if we approached $1 billion a year, sometime down the road when the deficit is reduced, that would be a very desirable goal. It would show that we have this national concern and it might reduce the pressure on universities to resort to earmarking to secure funds. So, that is another possible route, in addition to a congressional action that you described.

EARMARKING OF FUNDS

Chairman NUNN. Chancellor Wyatt, how do you characterize the thinking among university presidents about earmarking of funds? I know you are speaking to some extent for your colleagues. What are they saying these days? Do they have mixed views about it, or is it pronounced in one direction?

Mr. WYATT. There is some mix about it, but generally the majority, probably two-thirds to three-fourths, of the university presidents with whom I regularly communicate about this matter are against earmarking and have not done it, and have not participated in it. The others are across a broad spectrum.

You put your finger on it a moment ago. While I am describing this, I want to thank you and this committee for taking the stand you have. It has to start somewhere. We cannot get it everywhere unless it does start somewhere. And I would urge you to hold the line while we get the other committees and mechanisms in order. Because I think unless we do that, more and more university presidents are going to succumb to the pressure of various sorts to seek an earmark.

A colleague that will remain unnamed explained it to me this way. He said his Senator came to him and said, sir, I am going to have a center for technology transfer in this State. The State is depressed. The economy needs it. I'm going to do it. The only question in my mind, is it going to be at your university or is it going to be at the university across the State. Now, we can all take that story with a grain of salt, but that is exactly the way it was explained.

So, there are pressures that can be brought on university presidents, and I think that unless we now begin to completely eliminate earmarking, it is going to get much worse because the pressure will increase.

Chairman NUNN. Thank you very much, both of you, for testifying today. You have been very helpful to the committee.

Senator Warner.

Senator WARNER. Thank you, Mr. Chairman.

First, I would ask, Mr. Thurmond, would you like to go first for our side?

Senator THURMOND. You go ahead.

Chairman NUNN. Let me also say that Senator Gore has had to interrupt another meeting and when we can get to him, I would like to call on him.

Senator GORE. Could I take just 30 seconds now to welcome—I appreciate that very much. I just want to welcome Joe Wyatt. As the committee can determine for itself, he is an outstanding spokesman for America's universities. And living in Nashville as he does, I claim the privilege of welcoming him to the committee.

Senator WARNER. Would you yield?

Senator Thurmond and I just decided he would make a great U.S. Senator. [Laughter.]

Senator GORE. Well, Senator Sasser and I will discuss that matter and take it under advisement.

Senator WARNER. He looks like one and acts like one. [Laughter.]

Senator GORE. He has been looking at real estate in Virginia from what I understand. [Laughter.]

Mr. WYATT. No, not true.

Senator GORE. In any event, he would be good at whatever he does.

And I just want to say that I also appreciate Frank Press' friendship and statement.

I would underscore for my colleagues the recommendation by Joe Wyatt that we need a national investment strategy because this earmarking issue and the facilities issue are closely related. One puts pressure on the other and vice versa.

And I would recommend that we look also at the Tax Act of 1986 and this cap on $150 million in tax free bonds, and also the role of the President's science adviser in this and really focus on a national investment strategy to deal with the gradual dilapidation of our research apparatus.

I appreciate my colleague's courtesy and I enjoyed both statements. I apologize for leaving early.

Mr. WYATT. Thank you.

Chairman NUNN. Thank you, Senator Gore.

Senator GORE. And I will help you with the real estate. [Laughter.]

Chairman NUNN. Senator Warner.

Senator WARNER. Thank you.

Gentlemen, we are grateful for your taking the time to come up here. This is an important issue and I have supported our chairman on it. He made a tough decision because all of us around this table frankly live by pork barrel, and we are talking about pork in some grandiose terms. But bottom line it's pork.

I recall another period when I was in the Department of Defense as Secretary of the Navy, and the Vietnam war was at that time a very heated and contentious subject on the campuses across America. And frankly, it was with some difficulty that I and others had to make decisions in terms of allocation of funding to various universities and colleges.

WORKING RELATIONSHIPS BETWEEN UNIVERSITIES AND DEFENSE

Is that to be a factor—the cyclical receptivity of certain institutions? Quite frankly, some stuck it out through that period of time, and should they receive a little preference for having endured a rather difficult and contentious period in our history and stuck by the Department of Defense? How would you deal with that issue?

Mr. **Wyatt**. Let me respond to that. I am pleased to.

I think that we do go through cycles. We go through political cycles where we have varying degrees of objection to work for defense purposes. And I think we can provide for long-term relationships with laboratories like those that were described earlier, those eight that were described earlier. I believe the work there can be peer reviewed periodically for the quality of the science and should be. If it is not being done now, it should be so there wouldn't need to be setasides, earmarking, and we could all be certain that the quality of the work there was quite good.

Second, when any new facilities of this sort are established, and there is a relationship worked out between the Department and a university to establish a laboratory, that that be very carefully peer reviewed, competitively reviewed. I believe that can be done without earmarking. It can be done in a way that assures the quality of the facility, the cost of the facility and, in fact, it can assure, at least in my experience, some leveraging on the part of funds other than Department funds to support it from the State, perhaps from the institution and otherwise.

So, I do believe there will be cycles. We have a history of seeing that. But I do not believe that even though it is cyclic we cannot perform these activities, this research and development, without peer review. And we can do it without earmarking.

Senator **Warner**. Dr. Press, do you wish to address that issue?

Dr. **Press**. If I understand your question, I think you had in mind those universities which during that tumultuous period——

Senator **Warner**. Bailed out, to use an old naval term.

Dr. **Press**. Yes. But those are the universities, many of them, that invented the laser, the inertial guidance systems, the stored program computer. They were involved with developing artificial intelligence, even fission. And they have a lot to offer even today. So, I would appreciate their problems. They had very tough problems during those periods, and I think they have grown out of them and they are now contributing enormously.

Senator **Warner**. Indeed, they are. They stood the course. Some did, but some bailed out.

FACILITATING INTERAGENCY OPERATORS

Chancellor Wyatt, in your recommendation for a more comprehensive program for facilities investment, you observe that "mechanisms to facilitate interagency operation, coordination and funding government-wide effort will also be needed."

What specific steps would need to be taken?

Mr. **Wyatt**. I think there are several that are well within the course of possible activity; that is, when a particular research facility of any sort is felt to be needed, it can be broadly announced that it is needed and the competition can be held on that basis. We can encourage consortia.

In the case of the National Science Foundation's effort for supercomputers, we recognized that we would not be able to do one for everybody that needed one, much less wanted one. And so, these efforts were pooled. Five centers were established around the United States on a competitive basis.

So, I think that if we can develop a strategic plan that says the kind of facilities we generally need for basic or more applied research and to the level of funding that can be provided, it is well within the possibility of cooperative arrangements to do that and to produce the most effective use of the funds.

Senator **Warner**. Are there any obstacles under present law?

Mr. **Wyatt**. There are none under the present law that I can think of. Under present practice I think there are some, but not under present law.

Dr. **Press**. New legislation would help, wouldn't it?

Mr. **Wyatt**. It would help to free up some of the things, yes, enable this, to encourage it.

Senator **Warner**. Dr. Press, in assessing the point at which there are programs of sufficient quality emerging as a result of local or State efforts, what criteria should be followed?

Dr. **Press**. If a university wants to improve its standing and if it demonstrates, for example, that it is making an investment out of its own community resources to hire faculty, to partially fund buildings, to attract students, I think that those criteria should be used in judging whether or not they should receive a Federal facilities grant, for example, in this new program that I have envisaged. We certainly have to recognize the aspirations in many different parts of the country for universities to improve themselves.

And now that economic development is seen as closely related to science and technology and training of a qualified work force, more and more universities and more and more State governments will want to participate in these programs. I think that has to be recognized in a facilities bill. So, we should have a duality of purpose, helping the best institutions maintain their preeminent position and helping other institutions get up there to those heights.

Senator **Warner**. Thank you, gentlemen. It has been a very balanced and objective presentation.

Thank you, Mr. Chairman. My time has expired.

Chairman **Nunn**. Thank you.

Senator Bingaman.

Senator **Bingaman**. Thank you, Mr. Chairman.

M.I.T. INDUSTRIAL ASSOCIATES PROGRAM

I would like to ask about a slightly different issue that came up last week in the House in one of the hearings over there. I think Congressman Weiss raised it. He was critical of M.I.T.'s industrial associates program. And basically I think the argument went that here the Federal Government is using taxpayer dollars to provide very substantial research support to major universities in the country and for a fee of $50,000 or $100,000 a year, a corporation, whether it is U.S. or foreign—in this case many of the corporations that the testimony related to were Japanese firms—would come in and pay the fee and get some privileged access to the results of that research which was taxpayer funded. That was the argument.

My question is—is this a problem? Is this something that we need to concern ourselves with? It is something that we need to take some action to deal with? Or is this just a part of doing business? I don't know the answer to it. Dr. Press, maybe you would have a point of view or Mr. Wyatt, either one.

Dr. **Press**. Well, that is, of course, a tough question and an emotional one, and there is merit on both sides. I would say this.

The open nature of American universities, by and large, is responsible for their preeminent position. To start restricting them and who has access to them I think represents a trend in a direction that ultimately is undesirable.

On the other hand, we should insist on similar access to Japanese institutions that produce research as well. They may not be in Japanese universities because they do not have the research university system the way we do. But they do have national laboratories and they do have industrial laboratories which do the kind of research that you find at M.I.T. and elsewhere.

And so, rather than shutting down the American university to foreigners, whether it be students, or researchers, or industrial briefings, which is what M.I.T. does, I would insist on symmetrical access to Japanese institutions as the solution to this problem.

Senator **Bingaman**. My limited knowledge of this though is that most of the technology related research done in Japan is done in corporate laboratories, and the very large corporations do their own in-house research. Is it realistic for us to say that those private firms in Japan would have to open up their research laboratories to U.S. participation some way or other in return for us opening our public institutions to access by Japanese researchers? Is that a realistic demand?

Dr. **Press**. I think you have described the situation perfectly, that is, the asymmetry in the way both countries do their research.

Now, I think if we put it in the following way, it may be feasible. We would want access to their central research facilities where they do pre-commercial research, not the product development. And that would be the analog to what they find at our American research universities. If we do not get that kind of access, then I think we might want to consider some other possibilities in terms of restrictions.

We should also keep in mind that a lot of these Japanese companies have research and production facilities in the United States, and they want to be treated the way American corporations that have the same facilities in Japan want to be treated as being given equal access.

And so, I think the situation is an unstable one and in our negotiations with the Japanese, we have to insist on the kind of access that I described to you.

Mr. **Wyatt**. Let me support that. Rather than shutting down access as the first alternative to our laboratories in this country, I think we should do precisely what Dr. Press is suggesting, and that is, negotiate for more access.

The major problem that we have even with our open universities is the transition of ideas and research products from the laboratory into commercial products and services for American industry. The reason universities have these kinds of arrangements with companies, the reason that we have supported things like the research and development tax credit for industry and universities to co-invest in research and development is to try to make that transition from the laboratory to commercial products and services more efficient. We in my opinion must continue to do that. At the same time, we need to negotiate with Japan and others who have research capabilities for a two-way street on access to that research.

Senator **Bingaman**. But I guess both of you are saying that we could negotiate, but if the negotiations are not successful, then we should block access to our federally funded research if, in fact, access is not permitted to the Japanese research activity. Is that what I'm hearing from you?

Dr. **Press**. Well, I do not think we will reach that stage. Actually we have been talking to the Japanese, both government-to-government and my institution to an analogous institution in Japan. And they are beginning to provide just what I have described. It is moving slowly and we can ask them to speed it up, but they are providing access to their central facilities for the first time. And increasingly you will find foreigners working there on visiting appointments. This is now in industrial central research laboratories. I think the trend is in that direction. Whether the pace is fast enough is an item for discussion with them.

Mr. **Wyatt**. Let me say, in my view, it is not clear that this is a significant and serious problem for us, that is, that somehow the secrets are being stolen away. I think that our problem is we do not do a very good job or have not in the past. It is getting better for our own companies to stay in close touch with research activities in our own laboratories, and make use of that information, and have the reciprocal arrangement. I think that is what we need to work on as well.

Senator **Bingaman**. My time is up, Mr. Chairman. Thank you.

Chairman **Nunn**. Senator Thurmond.

Senator **Thurmond**. Thank you, Mr. Chairman.

Chancellor Wyatt and Dr. Press, we are very pleased to have you here today. I think your testimony has been most informative and very valuable.

FEDERAL RESEARCH FUNDING

Chancellor Wyatt, I was particularly impressed with your suggestion that Federal research funding should be matched by funds from non-Federal sources. In view of the constrained budgetary environment, this certainly would make limited Federal research funding go further.

In your opinion where would this non-Federal funding come from, and how successful would the program be in view of the fact that some of these research initiatives have limited commercial applications?

Mr. Wyatt. Well, that is a very good question. I am pleased to be given the opportunity to respond.

The notion of having open competitive processes for these research and development facilities and activities is to encourage those States and those universities, and even companies who see this as generally a way to develop a region, or develop a product or service, is something I think that can be very advantageous in leveraging Federal dollars.

When we did the NSF supercomputer centers, it is my recollection that for every dollar of Federal money that was put in, as a result of the competition for having one of these centers in a region, more than $2 was generated from State governments and from companies who were interested in participating in this as a portion of their economic future.

Speaking as the chief executive of a private university, I make that statement with mixed emotion because it is harder for me to raise money to do that, I think, than it might be for some public institutions. Nevertheless, I think it is such a sound practice that I recommend it. And, in fact, in the free electron laser example that I gave earlier, Vanderbilt University has invested $2.5 million of Vanderbilt money in that facility as a match for Federal funds. I think it is a healthy practice and I think it can only be achieved to the maximum with competitive activity rather than earmarking.

CONSORTIUMS TO VIE FOR THE FEDERAL RESEARCH DOLLAR

Senator Thurmond. Chancellor Wyatt, during the past year it has become common practice for universities to form consortiums in order to more effectively vie for the Federal research dollar. From my experience, these consortiums normally include institutions from different geographical regions and historical backgrounds to take advantage of all funding considerations.

How has this practice of forming consortiums impacted on the academic research environment?

Mr. Wyatt. First of all, let me say that I have participated in a variety of ways in consortiums related to the design and development of computer systems and computer networks. And I see them. We encourage them at Vanderbilt University and at other AAU members as a way of bringing the best talents available at a variety of institutions to work on a single problem, without duplicating the same talents at every institution. What we do is bring the best resources to a particular problem, usually having a variety of ingredients and disciplines, and in research areas within those disciplines, to a research area.

PRIORITIZING INSTITUTIONS FOR FEDERAL FUNDING

Senator THURMOND. Dr. Press, in your statement you indicate that $1.25 billion per year over a 5-year period would be required to correct the deficiencies in research facilities caused by years of neglect. Although you indicate that the funding should come from private, local and Federal funding, you did not indicate how to prioritize this funding. How would you designate the institutions that should receive this funding?

Dr. PRESS. In my testimony I did say that about $1 billion a year over a period of 5 years at a time when the country can afford that, perhaps a year or two down the road, would be what is needed to start removing this facilities deficit.

The general formula that has worked over the years is 50/50 funding where private resources or state resources, as the case may be, or a combination would be the non-Federal component.

I hope that the funding formula is somewhat flexible. There may be institutions that are very worthy where we should be making a facilities award that are not successful in raising the full 50 percent and some accommodation might be desirable in that case. I would have to think that out, but I hope that it would not be a very rigid formula.

To summarize, 50/50 seems right to me and manageable—that is what many of the university presidents tell me—but, again, with some flexibility in that number.

EARMARKING OF RESEARCH GRANTS

Senator THURMOND. Dr. Press, we all know that earmarking of research grants does not always result in the most effective use of the research dollar. Do you know of any instances where this approach has resulted in research projects that had no value or benefit for defense or commercial applications?

Dr. PRESS. I would put it this way. The earmarking often goes for projects that have no relation to Federal missions and yet they are camouflaged in terms of a Federal mission. The earmarking was done without any examination of whether there is a continuing commitment of the university to provide resources, whether that institution will qualify for Federal project support. You can have a beautiful building that is empty of people and equipment and facilities. These are the kinds of questions that should be asked that were not asked.

And so, without mentioning a specific project or institution, I would say that there are better ways to allocate Federal funds to ensure a better return on the investment than earmarking.

Senator THURMOND. I want to thank you both.

Mr. Chairman, I ask unanimous consent that my opening statement appear following the ranking member's statement.

Senator LEVIN [presiding]. It will be printed in the record. Thank you, Senator Thurmond.

Chancellor Wyatt, let me ask you a couple of questions.

Your statement today, as I understand it, is made on behalf of a number of organizations. Is that correct?

Mr. WYATT. That's correct.

ORGANIZATIONS POSITION ON THE EARMARKING ISSUE

Senator LEVIN. Have these associations and organizations taken formal positions on the earmarking issue?

Mr. WYATT. I can speak for one of them more than the others and it has been discussed on several occasions. The majority of the members in the Association of American Universities has taken a position against earmarking. That was confirmed recently in a meeting where about three-fourths of the membership voted against earmarks.

Senator LEVIN. Does that then become the position of the association?

Mr. WYATT. It becomes the position as much as a voluntary organization can manage to sustain it. As I said in the testimony, it becomes a matter of voluntary restraint. After that we still have a situation in which the majority of these people are restraining themselves. Others, for a whole variety of reasons that only they can explain, are choosing not to restrain themselves.

Senator LEVIN. You see, I think it is going to be very difficult for us to maintain our position here. We haven't really succeeded to date. I admire the effort, have joined in the effort, but I do not see it succeeding. And if it doesn't succeed, then we are all put in a very difficult position where our own States are not benefited by our participating in the same process of earmarking that other committees do participate in.

I think we are going to need some help from the grassroots level if we are going to succeed, and we need some strong help. You're voluntary associations—that's true, and I don't know what kind of persuasive capability you have over your members, but somehow or other, these associations are going to have to step forward, it seems to me, and say to Congress we oppose this process. Our membership by majority vote oppose this process. We have asked all of our members to resist the temptation because if we expect you folks to resist temptation, which is what you are asking us to do—basically, suggesting we do—and what we've tried to do, some of us—particularly the chairman and others on this committee—have tried to put the temptation aside. But if there is any chance of that succeeding, I believe it is going to be if we get some real help from you and your members.

Is there any chance that the associations that you are speaking on behalf of today might take strong positions on the earmarking issue and letting their membership know as to what they consider to be the obligation of universities and colleges under a regime of merit?

Mr. WYATT. Let me say I am pleased you put the question that way because it is a very difficult situation. And I would volunteer right now to convene a group of university presidents from these organizations to meet with you and other members of this committee and the Appropriations Committee perhaps to discuss this in some detail. But let me tell you what is happening also in those organizations.

Four years ago when we discussed this issue and the practice was less prevalent, we probably had 80 percent of the people or perhaps even higher that were solidly opposed to earmarking and said they wouldn't do it. And if you will excuse the vernacular, bit-by-bit over time, one-by-one people would come in and say essentially the devil made me do it. That is, I just had to do it. The regional development pressures were there. My board wanted it. My Member of Congress wanted it. Everybody else is doing it. Sort of the usual thing.

We have to draw the line, and we are going to have to draw the line together. That is the kind of conversation that Senator Nunn referred to that he and I have had; that is an offer to convene key members of this body, starting with this committee as an anchor point, as a beginning, to try to work out an arrangement, in my view, where the Congress would simply ban earmarking in these events in science research and science research facilities. And I believe we are going to have to do it together.

As Dr. Press mentioned earlier, many times we simply do not know that these earmarks are occurring until after they are done. They are done very, very quietly and they simply aren't evident.

And I might add finally that the position statement most recently, taken and those prior to it, by the Association of American Universities are attached to my testimony. I think you will find they are strong statements and unequivocal statements. However, as I said earlier, we find people one by one stepping over the line because of pressures that they feel they simply cannot resist.

Senator LEVIN. Well, the pressures around here are much greater.

Mr. WYATT. I don't deny that.

Senator LEVIN. If you have already talked about that kind of meeting with the chairman, then I won't press that any further. But it seems clear to me that if this earmarking continues, every single one of us is going to have to engage in that process. There is no way that, for very long, you can just have half of the Congress, or a third of the Congress, or whatever the number is, that participated in this effort without all of us doing it.

Mr. WYATT. I think that is what concerns me most.

Senator LOTT. Maybe we could just limit it to members of the Armed Services Committee. [Laughter.]

Senator LEVIN. We would be willing to do that in a minute. In fact, we could do that right now. Do you have a gavel? [Laughter.]

I gather then you have talked to the chairman about convening that kind of a meeting with presidents of various colleges and universities from these organizations?

Mr. WYATT. Exactly. That offer stands from our standpoint, and we would love to have the opportunity to meet with the appropriate Members of Congress and discuss it and try to work out some solution because I agree with you, the pattern is very clear. If we take the past 3 years and the trajectory of the earmarks, we are in for very big trouble very quickly unless we do something about it.

Senator LEVIN. Would you take up with each of these associations and councils the possibility of their adopting a very strong resolution on this subject, those who haven't done it? There are four different associations here I believe, are there not, that you are representing here today?

Mr. WYATT. That's right. I believe the strong statements are all in the testimony.

Senator **Levin**. Have they all adopted resolutions?

Mr. **Wyatt**. They have been voted by the membership.

Senator **Levin**. On all of these.

Mr. **Wyatt**. On all of these. That's right.

But my point is, you see, that these are voluntary organizations.

Senator **Levin**. I understand. There is no way to enforce it.

Thank you.

Senator Lott is next.

Senator **Lott**. Thank you, Mr. Chairman. Thank you, Chancellor Wyatt. Thank you, Dr. Press, for being here. I won't keep you much longer. I just have two lines of questioning I would like to get into.

EARMARKING

Now, with regard to the earmarking, continuing the line of questions that others have talked about and following up on your testimony, I guess I would sum it up in a vernacular that we might use out in some of the rural areas of Mississippi. I'm fer it and I'm agin it. And it is for these reasons.

I am for it because just as the Senator from Michigan was just pointing out, it is a matter of survival. If the Senator from Massachusetts gets some, the Senator from California, which is where a lot of it goes, and the Senator from Mississippi or Michigan stands mute, we are in a very difficult position politically. So, I'm for it from that standpoint in that it is a matter of survival.

I'm against it in that fundamentally it is a bad practice and we shouldn't be doing this. But I'm not going to agree to any kind of arrangement that would stop earmarking unless it is absolutely stopped across the board, one, and two, that there is a guarantee that whatever process takes place is fair.

I think one of the things that led to this earmarking was what I like to refer to as piling on; that is, the same schools get more and more of the money that goes to the universities in this area. And there is not a fair geographical basis for it. There is not even an academic basis for it in many instances. When it comes to engineering schools, Mississippi State University would compete with any engineering school in the country in my opinion. And I notice on some of your lists here, you do not have Georgia Tech listed—I mean, just as responding, and I realize that doesn't reflect anything other than the fact that they didn't respond.

But we have had this problem in the past with the way decisions are made. We have had the problem, for instance, at the National Science Foundation in the past. They used to complain vigorously about how it was the same limited number of schools that get a disproportionate amount of the funds.

So, I suspect that one of the reasons now some people are beginning to say, hey, we have to do something about this is because it is being spread out more. All of a sudden the Senator from Iowa, the Senator from Idaho, the Senator from Louisiana, the Senator from Mississippi, and the Senator from Florida are doing more. We are getting more of our share.

So, if we do not have the earmarking, what is the alternative? And how can we be sure that it is not going to be scientists that are awarding these grants on their own personal prejudices or the Department of Defense people with preferences or prejudices in favor of schools or that would base their decision, at least to a degree, on what we had in the super collider whereby two factors that were considered were accessibility to an international airport and availability of jobs for spouses. Pretty poor criteria to make a geological or scientific decision.

How do you respond to that, Chancellor Wyatt?

SUPER COLLIDER COMPETITION

Mr. WYATT. Let me take the last one first because it turns out that Tennessee was one of the three finalists in the super collider competition. And I was reasonably close to the proposal that was submitted and to the process. And I personally believe that the major criterion there was geology. I personally believe that the best geology probably won or at least it was tied for the best geology, and that in fact those other things, the accessibility for scientists to get to the place and do their work, certainly played a role.

Senator LOTT. Those two were in the top five items of consideration as I learned after the fact.

Mr. WYATT. That's right.

Senator LOTT. And I think that is a very, very poor basis for a decision.

Mr. WYATT. Well, again, I wasn't inside the decisionmaking process, sitting at the table doing the decisionmaking. That would not have been appropriate for me to do. But, in fact, looking at it in retrospect, even though Tennessee did not win this, it did not come close to Vanderbilt, I am not dissatisfied with the way that decision went. I think that it was a good call. It was done out in the open. I think that the winning State got behind it in additional ways, not the least of which was a pledge of $1 billion to support it, and had all the other of the five issues covered as well. That is a personal view, but I was reasonably close to it, particularly in the aftermath of figuring out how it was that one of the finalists didn't win.

Senator LOTT. I do not want to get off on a discussion of the super collider other than to point out there were some criteria used there I think were highly questionable. And how does that relate to earmarking and how we deal with this piling on, and how do we make sure there is a fair distribution, and how do we make sure that it's not some scientist making a decision from the same prejudices that perhaps a Senator would make those decisions?

Mr. WYATT. I want to let Dr. Press respond to that, but let me just take a second while I am talking here to respond to that specific issue.

I have been a member of a faculty and administrator at three universities: the University of Houston, Harvard University, and now Vanderbilt. And I have seen a variety of the sort of networks that you refer to, that is, those who get all the work, those who don't. I have served on peer review panels of all sorts. I have been a loser in many competitions where my proposal wasn't picked, and I have been a winner in some.

And I have seen the results of earmarks. I guess the first thing I noticed as a small boy in east Texas was that the road to the county commissioner's house was paved and mine wasn't. So, it was an early experience in sort of how things might work.

I think it would be an absolute disaster for this country to get further into the earmarking issue and not deal with science and science research and science facilities on a competitive peer review basis. My experience is solidly positive that, in fact, it is generally fair, that there are very, very few abuses, if any, that amount to anything, and that when a group of scientists or engineers sit down to judge a proposal, generally you will find them behaving at their very best. They simply do not react to their own self-interest. They respond to the high ground on the quality of the science. That is a personal opinion. And I simply think it works that way.

And I notice that Mississippi and Mississippi State University do right well in this competitive process.

Senator LOTT. They have done pretty well with a couple of earmarks too. [Laughter.]

And they are going to do fine with the projects they have. They are very capable, very qualified in engineering, aerospace engineering, right down the line. And yet, I still worry about how does, you know, a Georgia Tech, Vanderbilt, Mississippi State University, University of Mississippi or University of Idaho compete, which they can in many particular instances, with a Harvard or a Stanford because we are, after all, all paying for this. And so, why shouldn't there be a fair geographical distribution especially when you have a university that, as a matter of fact, could do just as good a job.

It is just like doing architectural work for the Navy. It is hard to get in the tent. Once you get in the tent, all of a sudden you are getting all kinds of architectural work. You are on their list. You're in the deal, not that anything is being done wrong. It is just that all of a sudden if they are going to need an architect in Tennessee, well, they say, there's old so and so. And once you get in the cycle, then you do fine. And I think it also is applicable in these. Once you get in the tent, then you get it almost automatically.

Mr. WYATT. Well, Senator, I can accept the proposition that this country may want to declare as a priority, and has done that in a number of agencies, that research facilities should be developed across the land. There should be some geographic distribution. But I submit, since we are both describing institutions in the Southeast, that it is almost certainly true that the Federal Government could get the best value for its dollar, if it wished to have a facility in the Southeast, to put it into play for the five or six southeastern States and say let's have proposals. Let's don't do it through the back door. Let's do it through the front for whatever science research facility is needed. And I would submit that the evidence suggests that we would get a lot more for our money as a country that way than we do any other way. And it can be managed that way. We have some illustrations where it is.

Senator LOTT. Dr. Press, do you want to comment on any of that?

Dr. PRESS. Well, I can't add too much to what Chancellor Wyatt has said.

DISTRIBUTION OF FEDERAL GRANTS

The largest factor that correlates with the distribution of Federal grants is a very simple one. It is the number of scientists and engineers in that particular State. Twenty-five percent of the Nation's scientists and engineers live in California, and so it is not a surprise that California ranks very high in the awards. There are more of them. It is as simple as that.

You were absent during my testimony, and I proposed that we have two kinds of facilities grants: one on the basis of a national competition, and one on the basis that admits applications from aspiring institutions to improve themselves, to get their nose under the tent. And I think if we did both of those, the Nation would be ahead because we are increasing the basic resource, the science and technology base of the country, as well as maintaining the great strength that has led to this country's preeminence in science.

And it seems to me that if we had a facilities program of the kind I have just described, the pressure for lobbying and earmarking would be much reduced.

Senator LOTT. Would you just allow me one more question? And this is not related to earmarking.

I always worry about relating what we do in the Government or in research at a university or what we learn from NASA, for instance, to the real world. How do we transfer it to the real world? How do we get the small businessman to benefit from that knowledge?

I also worry sometimes about whether do we lose what we learn in an academic atmosphere in a research project in making it applicable to what we really need in the Department of Defense. I know in a lot of instances, obviously, it works. I have some reservations about it working in other instances. Sometimes I think we are more supporting the university than we are getting the research we need for DOD.

IMPROVING MANUFACTURING EFFICIENCY/REDUCING WEAPON PROCUREMENT COSTS

But let me give you a specific question. Do you know whether or not there is an effort to try to find a way to improve manufacturing efficiency with a view to reducing weapon procurement costs, something of that nature?

Dr. PRESS. I believe the Department of Defense has such a program to do precisely that, to increase the productivity of American manufacturers in the interest of improving the quality and lowering the costs of defense procurement. It is not a very large program, but they do invest in robotics, in computer automated manufacturing and training of people along these lines. It has a name, Mantech. It might be examined to see if it is an adequate program. But they understand the question and they are worried about it.

Senator LOTT. Thank you.

Senator LEVIN. Thank you to our witnesses. We are most appreciative.

We will stand adjourned.

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR SAM NUNN

NATIONAL DEFENSE STOCKPILE TRANSACTION FUND

Senator NUNN. How many Defense Department research or construction projects have been initiated with funds specifically "earmarked" from the National Defense Stockpile Transaction Fund?

Dr. DUNCAN. Between fiscal years 1986 and 1989, Congress used the National Defense Stockpile Transaction Fund as a vehicle through which to appropriate funds for 15 projects intended for 10 recipients. Because these earmarks are statutory and must therefore be carried out, grants providing these funds are in process as required.

Senator NUNN. How much has been appropriated for these projects?

Dr. DUNCAN. Congress has appropriated $81,520,000 for these projects.

Senator NUNN. Do you believe this is an appropriate use of the funds from the Stockpile Transaction Fund?

Dr. DUNCAN. While the National Defense Stockpile Transaction Fund's mission is to acquire and store strategic and critical materials for national defense purposes, the projects directed by Congress to be funded using the Transaction Fund as a vehicle for award and accountability, have principally been university facilities construction projects. It should be noted that the fund is a revolving fund and none of the balance available to support the mission has been used to fund the earmarks in question. Rather, Congress has appropriated funds for specific earmarks over and above the amounts necessary to accomplish the mission and objectives of the National Defense Stockpile Transaction Fund.

Senator NUNN. Have any of these specific projects been requested or supported by the administration?

Dr. DUNCAN. The administration has neither requested nor supported any of these specific projects.

Senator NUNN. What benefits has the Defense Department as the Manager of the National Defense Stockpile received from these "earmarked" projects to date?

Dr. DUNCAN. The Defense Department, as the Manager of the National Defense Stockpile, has not received any benefits from these "earmarked" projects to date. The projects are all in the developmental or under-construction stage.

Senator NUNN. Is the Defense Department requesting or supporting any specific grants or contracts for research or construction from the National Defense Stockpile Transaction Fund in fiscal year 1990?

Dr. DUNCAN. No.

Senator NUNN. As currently enacted, would section 220 of the Fiscal Year 1989 Defense Authorization Act preclude the Secretary of Defense in the future from awarding these types of "earmarked" contracts from the National Defense Stockpile without competition? Do you believe there should be a requirement for competition for these types of grants and contracts from the Stockpile Transaction Fund?

Dr. DUNCAN. Yes, section 220 would apply to the extent that the grants or contracts are "for the performance of research and development, or for the construction of any research or other facility." DOD opposes earmarking and concurs with the assessment of the conferees to the Fiscal Year 1989 Defense Authorization Act that "earmarking research funds is not an acceptable practice and has an adverse effect on support efforts for creative, energetic basic research. Federal funding should be awarded to academic institutions under a competitive process." We believe there should be a requirement for competition for these types of grants and contracts from the Stockpile Transaction Fund and that the projects should be responsive to specific needs identified by the National Defense Stockpile Manager.

CENTER FOR STRATEGIC STUDIES

Senator NUNN. Are you aware of the efforts of a local university to seek DOD funds to finance part of the construction of a Center for Strategic Studies on its campus?

Dr. DUNCAN. Yes.

Senator NUNN. According to the university involved, the justification for this DOD contribution is that this Center will be used "for a specialized geopolitical economic education program" for National Guard officers. Is there a requirement for this type of educational program for National Guard officers?

Dr. DUNCAN. Generally, the existing training provided to National Guard officers is more than sufficient to meet the combat proficiency and organizational skill levels required. Under circumstances such as full mobilization, it is conceivable that some selected National Guard officers may serve at high levels of responsibility.

DOD programs are currently available to educate officers at these senior levels of authority, and the education suggested in this proposal is not essential or necessary to the National Guard mission.

Senator NUNN. If so, why can't this type of program be accommodated with the existing educational community within DOD—for example, by the National Defense University?

Dr. DUNCAN. The education level and programs which this center would provide are available within existing DOD programs. National Guard officers participate in all of the senior service colleges and as Senior Security fellows pursuing national strategy courses at Harvard University, Fletcher School, Tufts University, Ohio State University and Georgetown University. Additionally, abbreviated strategy and security courses are conducted annually at the Army War College and Harvard University, as well as a 1-week national strategy seminar conducted several times a year in Washington, D.C. Availability of auditorium and classroom facilities for these types of courses is being enhanced under an already existing project to construct a new National Guard office complex at Arlington Hall Station. These programs meet all current and projected requirements for this level of education.

Senator NUNN. Does the Department of Defense plan to make any funds available for this particular project in the current fiscal year?

Dr. DUNCAN. Based on the current availability of DOD educational programs which provide similar skill training, there are no plans and no identified need to fund this project.

Senator NUNN. Does the Department support Congress providing any funds for this project in fiscal year 1990?

Dr. DUNCAN. No.

[Whereupon, at 4:20 p.m., the committee was adjourned.]

DEPARTMENT OF DEFENSE AUTHORIZATION FOR APPROPRIATIONS FOR FISCAL YEARS 1990 AND 1991

WEDNESDAY, JUNE 21, 1989

U.S. Senate,
Committee on Armed Services,
Washington, DC.

ICBM MODERNIZATION PROGRAM

The committee met in open session, at 9:32 a.m., in SR-222, Russell Senate Office Building, Senator J. James Exon presiding.

Committee members present: Senators Nunn, Exon, Levin, Dixon, Gore, Warner, Thurmond, Cohen, Wallop, Gorton, Lott, and Coats.

Committee staff member present: Arnold L. Punaro, staff director.

Professional staff members present: Robert G. Bell, William E. Hoehn, Jr., T. Kirk McConnell, and Michael J. McCord.

Minority staff members present: Patrick A. Tucker, minority staff director and counsel; Romie L. Brownlee, deputy staff director for the minority; Brian D. Dailey, George W. Lauffer, John E. Mansfield, Durwood W. Ringo, Jr., and Mark E. Robinson, professional staff members.

Staff assistant present: Mickie Jan Wise.

Committee members' assistants present: Jeffrey B. Subko, assistant to Senator Exon; Kenneth N. Luongo, assistant to Senator Levin; William J. Lynn, assistant to Senator Kennedy; Milton D. Beach, assistant to Senator Glenn; Leon S. Fuerth, assistant to Senator Gore; Terrence M. Lynch, assistant to Senator Shelby; Grayson F. Winterling, assistant to Senator Warner; James M. Bodner, assistant to Senator Cohen; Dudley L. Carlson, assistant to Senator Wilson; Anthony H. Cordesman, assistant to Senator McCain; Jack D. Crouch II, assistant to Senator Wallop; Robert M. Soofer, assistant to Senator Gorton; Lawrence M. Lesser and Charles G. Pearcy, assistants to Senator Lott; and Eric H. Thoemmes, assistant to Senator Coats.

OPENING STATEMENT OF SENATOR J. JAMES EXON, PRESIDING

Senator Exon. The committee will please come to order.

The Senate Armed Services Committee today meets to receive testimony on the administration's ICBM modernization program in review of S. 1085, the Defense authorization bill for fiscal years

1990 and 1991, which we will begin to mark up following the 4th of July recess.

The issue of ICBM modernization has been contentious for most of this decade. The United States has made precious little progress in modernizing our ICBM force or in reducing its vulnerability to Soviet pre-emptive attack.

I shall not undertake to recount this dismal history, even in brief. Suffice it to say that the new administration has proposed to proceed with both the rebasing of MX missiles in a Rail Garrison configuration with an IOC of 1992, and simultaneous development and deployment of the Small ICBM in a basing mode yet to be fully established, with an IOC of 1997.

Secretary Cheney said last week when he sent a letter to the committee that DOD has increased the funding for the Small ICBM in the fiscal years 1992 through 1994 budgets by a total of $947 million to augment the basing work. Without objection, I shall place a copy of Secretary Cheney's letter in the record following this opening statement by the chairman.

Needless to say, the administration's ICBM modernization program has not escaped congressional criticism. Some favor Midgetman and would abandon MX or hope to negate it in some way. Some favor the MX in Rail Garrison and question the need for the far more expensive Midgetman. Some favor neither program and would reallocate ICBM modernization funds elsewhere. And finally, some favor proceeding with both programs.

In the years past, this Senator has strongly supported the Rail Garrison MX program and questioned the wisdom of significantly greater expenditures to also deploy the Small ICBM. Yet, increasingly I am persuaded we must agree to do both if we are to do anything in ICBM modernization. I do not believe we can afford to do nothing about the vulnerability of our silo-based ICBMs.

In my judgment, the most likely cause for a nuclear war, remote as that is, would be a war in Europe. In that instance, NATO policy calls for the resort to nuclear weapons by NATO but in limited attacks. In that instance, our silo-based ICBMs are sitting ducks. They cannot run and hide. Thus, we need to rebase the MX on trains, which would allow our ICBMs to run and hide under the most likely war initiated scenario. Therefore, I intend to support the administration's ICBM modernization program in full at my subcommittee markup, unless our distinguished witnesses persuade me today to do otherwise.

Our witnesses today are Ambassador Paul Wolfowitz, the Under Secretary of Defense for Policy, and General Larry Welch, the Air Force Chief of Staff.

Welcome to you both.

Dr. Wolfowitz, you have become such a familiar figure here before the committee that we may have to find office space for you.

Before we proceed with the testimony, I would like to ask if there are any other opening statements by members of the committee? I know that my friend and colleague, the ranking minority member, Senator Thurmond, will be here, and at that time we will recognize him for his opening remarks.

Senator Cohen, any opening remarks?

Senator COHEN. No, Mr. Chairman.

Senator EXON. Senator Gore, any opening statement.

Senator GORE. No.

Senator EXON. I will submit for the record a letter from Secretary Cheney.

[The letter from Secretary Cheney follows:]

THE SECRETARY OF DEFENSE,
Washington, DC, June 15, 1989.

Hon. SAM NUNN,
Chairman, Committee on Armed Services, U.S. Senate, Washington, DC.

DEAR MR. CHAIRMAN: As I have stated previously, the Administration is committed to deployment of Peacekeeper Rail Garrison and the Small ICBM in sequence. Specifically, we will begin fielding Rail Garrison in 1992 and we will achieve initial operating capability (IOC) for the Small ICBM in 1997.

While the amended budget contains sufficient funding for Rail Garrison, further review of the Small ICBM program indicates the need for additional funds beyond the FY 90–91 budget request. As currently structured in the amended budget, the Small ICBM program focuses primarily on certification of the missile. However, an additional $947 million is required between FY 92–94 to conduct the basing work necessary to ensure a 1997 IOC. Therefore, I have decided to increase funding for the Small ICBM as follows: $288 million will be added in FY 92, $274 million in FY 93 and $385 million in FY 94. Along with this funding increase, we have a requirement to add $100 million of FY 89 funds to the program. Given that requirement, I urge you to approve the request currently on the Hill to reprogram $100 million from Rail Garrison to the Small ICBM. The FY 89 amount remaining for Rail Garrison still supports the FY 92 IOC for that system.

The President and I are committed to a two-missile ICBM modernization program and we intend to achieve the program milestones I have outlined above. I look forward to your support on this and other vital national security issues.

Sincerely,

DICK.

Senator EXON. I would also like to submit for the record the opening statements of Senator Alan Dixon and Senator John Warner.

[The prepared statements follow:]

PREPARED STATEMENT OF SENATOR ALAN J. DIXON

As part of the ongoing review of the amended 1990–1991 defense budget, the committee will receive testimony today concerning one of the most controversial aspects of the administration's defense proposals: should we modernize our intercontinental ballistic missile (ICBM) force by building two weapons systems at a time when we can ill-afford to do so?

The administration has proposed to remove 50 multi-warhead MX ICBM missiles from silos and place them on railcars by 1994, while slowing single warhead Midgetman ICBM development until program ramp up begins in 1995.

Like many other decisions facing this committee, the decision of how to modernize our ICBM force will be a difficult one. There are several trade-offs in selecting one system over another. The rail-based MX is cheaper, our best ICBM against hardened targets, and mobile, if it can survive a surprise nuclear attack. On the other hand, the Midgetman will likely survive a surprise nuclear attack, a key capability to consider, particularly for those who believe the United States is increasingly becoming vulnerable to a Soviet first-strike attack.

This committee's decision concerning ICBM modernization is further complicated by strategic arms control talks. Our modernization strategy is greatly impacted by proposals to ban or limit mobile missiles and to place numerical limits on the number of nuclear delivery vehicles, re-entry vehicles, et cetera, that each side can have.

Not only do we have to make prudent decisions that will maintain our nuclear deterrence and our ability to flexibly respond to arms control initiatives, we have to be fiscally responsible while doing so. In an era of tight budgets, we cannot afford to procure systems that only marginally improve our national defense; rather, we need to ensure that we get the best bang for the buck.

The testimony that we will receive here today will improve this committee's understanding of the administration's proposals. I look forward to the comments of our distinguished witnesses.

PREPARED STATEMENT OF SENATOR JOHN WARNER

Mr. Chairman, it is a pleasure for me to join you in welcoming Secretary Wolfowitz and General Welch to testify today. It is a particularly apt instant that they come before the committee, since in the past few days we have seen the development of what might happily turn out to be a degree on consensus on the issue of the Small ICBM and MX Rail Garrison that we have not had before.

Yesterday morning the President met with the congressional leadership of both parties to stress the importance of the strategic modernization program and to seek bipartisan support for funding the program.

Let me review briefly that meeting. The President outlined his reasons for needing our unified support for the modernization program he has submitted to the Congress:

—He fully supports both the MX Rail Garrison and the Small ICBM programs;

—The two-missile program is essential for maintaining the credibility and integrity of the strategic deterrent;

—Full funding for SDI is essential to the survivability and credibility of the strategic deterrent;

—Bipartisan support for the two mobile ICBMs and for strategic defense is essential if he is to negotiate from strength and flexibility.

And Secretary Cheney has assured both Armed Services Committees by letter that both ICBM programs will be funded and deployed.

Finally, the Vice President met with all the Republican members of the committee yesterday afternoon to discuss in detail the very important relationship between our strategic modernization and our negotiating strategy in Geneva. We are all committed to working closely with the President to ensure that our strategic modernization program, including both land-based ICBMs and strategic defenses, moves forward in a way to give the President the flexibility necessary at the START negotiating table to produce a treaty that is in the national security interest of the United States.

I hope that today, as the witnesses explain the progress, plans, and potential of these ICBM programs, we may begin to build the support in the committee and in the Senate to authorize the program that the President needs.

Senator EXON. Dr. Wolfowitz, we are glad to recognize you.

STATEMENT OF PAUL D. WOLFOWITZ, UNDER SECRETARY OF DEFENSE FOR POLICY

Mr. WOLFOWITZ. Thank you, Mr. Chairman. And may I thank the committee and the staff of the committee for the effort that I know they are making to expedite the processing of the two nominations that the President has just made for Assistant Secretaries in my area, which will take a bit of the burden off of me being up here every day. We would like to get them confirmed, and I know your staff has been working very hard to make sure that happens quickly.

And let me assure you, Mr. Chairman, our purpose is not to talk you out of your position. We think that is exactly the right position, and we hope you will support the President's program.

As the committee is aware, the administration has been engaged in a major review of our national security policy. In examining the range of strategic issues, we came to a number of conclusions that I would like to share with you before turning specifically to the ICBM modernization question.

Our review reconfirmed the need for a triad of strategic offensive forces. The three legs of our deterrent provide together far more than the simple sum of their parts. Each leg has unique strength and capabilities, which as a whole provide the President what he requires in order to have an effective, flexible deterrent that is capable of meeting and therefore deterring a wide range of potential threats.

The strategic modernization program, begun by the Reagan administration in the fall of 1981, has been highly successful. It has redressed many of the strategic deficiencies with which we entered this decade, strengthened our deterrent by offsetting previously existing Soviet advantages, such as prompt hard target kill, and provided the basis for significant progress in arms reduction.

Because the strategic relationship is dynamic, however, and because the Reagan program was designed to modernize all three legs of the triad over a 15- to 20-year period, much work remains to be done. We need to continue to modernize the submarine, the bomber, and the ICBM legs, as well as the critical C3I systems that support them.

The deployment of 50 Peacekeeper ICBMs and the modernization of the Minuteman force have provided a highly capable deterrent that can hold at risk virtually the entire spectrum of Soviet targets. What the ICBM force cannot do today, however, is to deny the Soviets the ability to target even a portion of our forces in a pre-emptive attack. The committee is well aware that this question has been at the heart of almost two decades worth of debate and controversy that has surrounded ICBM modernization. All of this formed the essential background for our review.

We concluded that it would indeed be desirable from a deterrent standpoint that at least a portion of each triad leg be survivable. Our alert bombers and our SSBNs at sea meet this criterion today. If some of our ICBMs were survivable, this would provide, among other things, a hedge should vulnerabilities emerge in the bomber or submarine legs, and, in conjunction with the alert bombers and at-sea SSBNs, provide the strongest possible deterrent against Soviet pre-emptive attack.

After considering all of this, we analyzed the various situations in which our ICBM silos might be attacked. Two potential scenarios seem fundamental here. The first would be a Soviet strike arising out of an intense crisis, perhaps even one that had already resulted in a conventional war between the United States and the Soviet Union. And second, what is sometimes called a "bolt from the blue" attack, occurring in the absence of any acute international crisis or hostilities.

We have made great progress in rebuilding our triad, and we do not believe that deterrence is likely to fail. A failure of deterrence and an attack on our ICBM silos is extremely unlikely, but that is because we have invested heavily to make our deterrent effective, and we must continue to do so in the face of an evolving threat. It is important that we have adequate deterrence against both of the above scenarios, but we are proceeding sequentially with the two missile programs because of their different states of development and because doing so is responsive to the threat and to fiscal realities.

The means to hedge against the first type of threat is at hand, can be deployed fully in a short amount of time, and is eminently affordable. By removing the existing 50 Peacekeeper missiles from their silos and deploying them in the Rail Garrison basing mode, for an overall program cost of about $6 billion, in 3 years we can have 50 Peacekeeper warheads ready to become fully survivable, and in 5 years we will have the full 500 warhead Peacekeeper force capable of doing this.

The solution to the second scenario, in which we would have only tactical warning of an attack, lies in the deployment of the new Small ICBM. We could not begin deploying the Small ICBMs on their hardened mobile launchers until the late 1990s, well after the time that we could rebase 50 Peacekeeper missiles into Rail Garrison. As a result, based on both the immediacy of the threat, the maturity of the technology, and the fiscal situation, the President elected to proceed with this program but to deploy the 50 Peacekeepers first. Over the next several years we will be studying how and where to base the Small ICBMs, how many of them we will require, what their optimum payload might be, and what steps we might take to reduce the cost of the overall program.

In the absence of a START agreement, the United States must be in a position to deploy a mobile ICBM force comparable to that of the Soviets. We must not find ourselves in a position where the Soviets have survivable ICBMs and we do not. The Soviets are way ahead of us in this field, having deployed two mobile ICBM systems while ours is still on the drawing board.

Before permitting mobile ICBMs under a START agreement, we must make certain that any limits on those systems are effectively verifiable. Otherwise, the security benefits to the United States of deploying mobile ICBMs might not be worth the risks of Soviet cheating. To obtain Soviet agreement to a satisfactory START outcome, it is essential that we demonstrate that we are willing and able to deploy mobile systems ourselves.

The START negotiations resume this week in Geneva. Significant issues remain between ourselves and the Soviets, in addition to verification. As a result, we cannot, in fact, predict when a treaty might be ready for signature. Furthermore, it would be imprudent to begin tailoring our strategic forces to reflect what is still an incomplete and unagreed document. In addition to the deterrent advantages that they provide, proceeding with the Rail Garrison Peacekeeper and the Small ICBM represents prudent steps and a hedge against the failure to achieve a treaty that is in the United States' interest.

Mr. Chairman, the President's program represents sound deterrent policy. It represents sound fiscal policy. It represents sound arms control policy. It prudently balances the risks and opportunities that we face in the upcoming years.

I believe we have an opportunity today to put the debates of the past behind us. Proceeding along the path outlined in the budget now before you, we can address in a measured fashion both the strategic and the budgetary difficulties that have proven so hard to manage before.

But the flip side of all of this, Mr. Chairman, is that radical changes to the two missile programs will cause additional problems. Delaying Peacekeeper would add to its cost and impede our ability to solve rapidly a vulnerability in our strategic posture that corresponds to the more plausible of the threats that we must deter.

Forcing acceleration of the pace of decisions on the Small ICBM would lead us to field prematurely a missile that could be more costly than it needs to be, and one which might not be deployed in the manner best suited to its deterrent potential. Furthermore—and Mr. Chairman, I think this is the most important point—our failure to demonstrate that we have forged a consensus on ICBM modernization would reduce our negotiators' leverage in Geneva by causing the Soviets to believe that we will simply never deploy mobile ICBMs, and therefore, that they do not need to take account of such a prospect in the positions they take in the START talks.

We have spent enough time debating this question. The President's program is a thoughtful, logical answer to what has often seemed an intractable set of issues. Our program deserves the support of the Senate and of the entire Congress, and I urge the committee to support it and the other critical elements of the strategic modernization program.

[The prepared statement of Mr. Wolfowitz follows:]

PAUL WOLFOWITZ

UNDER SECRETARY OF DEFENSE FOR POLICY

BEFORE THE SENATE ARMED SERVICES COMMITTEE

Mr. Chairman, Members of the Committee:

It is a pleasure to appear before you with General Welch to discuss the Administration's program for ICBM modernization.

As the Committee is aware, the Administration has been engaged in a major review of our national security policy. In examining the range of strategic issues, we came to a number of conclusions that I would like to share with you before turning specifically to the ICBM modernization question.

The Strategic Triad

Our review reconfirmed the need for a Triad of strategic offensive forces. The three legs of our deterrent provide together far more than the simple sum of their parts. Each leg has unique strengths and capabilities which, as a whole, provide the President what he requires in order to have an effective, flexible, deterrent which is capable of meeting -- and therefore deterring -- a wide range of potential threats.

The strategic modernization program begun by the Reagan Administration in the fall of 1981 has been highly successful: it has redressed many of the strategic deficiencies with which we entered this decade, strengthened our deterrent by off-setting previously existing Soviet unilateral advantages such as prompt hard target kill, and provided the basis for significant progress in arms reductions. Because the strategic relationship is dynamic, however, and because the Reagan program was designed to modernize all three legs of the Triad over a fifteen to twenty year period, much work remains to be done. We need to continue to modernize the submarine, the bomber, and ICBM legs, as well as the C^3I systems which support them.

THE ICBM FORCE:

The deployment of 50 Peacekeeper ICBMs and the modernization of the Minuteman force have provided a highly capable deterrent which can hold at risk virtually the entire spectrum of Soviet targets. What the ICBM force cannot do today, however, is to deny the Soviets the ability to target even a portion of the force in a pre-emptive attack. The Committee is well aware that this question has been at the heart of the almost two decades worth of debate and controversy which have surrounded ICBM modernization. All of this formed the essential background for our review.

We concluded that it would indeed be desirable from a deterrent standpoint that at least a portion of each Triad leg be survivable. Our alert bombers and our SSBNs at sea meet this criterion today. If some of our ICBMs were survivable, this would provide, among other things, a hedge should vulnerabilities emerge in the bomber or submarine legs, and, in conjunction with the alert bombers and at-sea SSBNs, the strongest possible deterrent against Soviet preemptive attack.

After considering all of this, we analyzed the various situations in which our ICBM silos might be attacked. Two potential scenarios exist:

- a Soviet strike arising out of an intense crisis, perhaps even one that had already resulted in a conventional war between the US and the Soviet Union; and
- what is sometimes called a "bolt-from-the-blue" attack, occurring in the absence of any international crisis or hostilities.

We have made great progress in rebuilding our Triad, and we do not believe that deterrence is likely to fail. A failure of deterrence and an attack on our ICBM silos is extremely unlikely, but that is because we have invested heavily to make our deterrent effective, and we must continue to do so in the face of an evolving threat. While it is important that we have adequate deterrence against both of the above scenarios, we are proceeding sequentially with the two missile programs because of their different states of development and because doing so is responsive to the threat and to fiscal realities.

The President's Program

The means to hedge against the first type of threat is at hand, can be deployed fully in a short period of time, and is eminently affordable. By removing the existing 50 Peacekeeper missiles from their silos and deploying them in the rail garrison basing mode -- for an overall program cost of about $6 billion -- in three years we can have 50 Peacekeeper warheads ready to become fully survivable in the event of international crisis or conventional conflict, and in five years we will have the full 500 warhead Peacekeeper force capable of doing this.

The solution to the second scenario, in which we would have only tactical warning of an attack lies in the deployment of the new small ICBM (SICBM). We could not begin deploying the SICBMs on their hardened mobile launchers, until the late 1990s, which is well after the time we could re-base 50 Peacekeeper missiles into Rail Garrison. As a result, based on both the immediacy of the threat, the maturity of the technology, and the fiscal situation, the President elected to proceed with this program but to deploy the 50 Peacekeepers first. Over the next several years, we will be studying how and where to base the SICBMs, how many of them we will require, what their optimum payload might be, and what steps we might take to reduce the cost of the overall program.

ARMS CONTROL CONSIDERATIONS

It seems clear that in the absence of a START agreement, the United States will want to be in a position to deploy a mobile ICBM force comparable to that of the Soviets. The United States must not find itself in a position where the Soviets have survivable ICBMs and we do not. The Soviets are way ahead of us in this field, having deployed two mobile ICBM systems. Ours are still on the drawing board.

Before permitting mobile ICBMs under a START agreement, we wish to make certain that any limits on those system were effectively verifiable. Otherwise, the security benefits to the United States of deploying mobile ICBMs might not be worth the risks of Soviet cheating. To obtain Soviet agreement to a satisfactory START outcome, it is essential that the United States demonstrates it is willing and able to deploy a mobile system.

The START negotiations resumed this week in Geneva. Significant issues remain between ourselves and the Soviets, in addition to verification. As a result, we cannot, in fact, predict when a Treaty might be ready for signature. Furthermore, it would be imprudent to begin tailoring our strategic forces to reflect what is still an incomplete and unagreed document. In addition to the deterrent advantages which they provide, proceeding with the rail-garrison Peacekeeper and the Small ICBM represent prudent steps and a hedge against the failure to achieve a Treaty in the U.S. interest.

CONCLUSION

Mr. Chairman, the President's program represents sound deterrent policy. It represents sound fiscal policy. And it represents sound arms control policy. It prudently balances the risks and opportunities we face in the upcoming years. I believe we have an opportunity today to put the debates of the past behind us. Proceeding along the path outlined in the budget now before you, we can address, in a measured fashion, both the strategic and the budgetary difficulties which have proven so hard to manage heretofore.

The flip side of all of this, of course, is that radical changes to the two missile program will cause additional problems. Delaying the Peacekeeper program will add to its cost and impede our ability to solve rapidly a vulnerability in our strategic posture which corresponds to the more plausible of the threats we have to deter. Forcing acceleration of the pace of decisions on the SICBM could lead us to field prematurely a missile which could be more costly than it need be, and one which is not deployed in a manner best suited to its deterrent potential. Furthermore, our failure to demonstrate that we have forged a consensus on ICBM modernization could well reduce our negotiators' leverage in Geneva by causing the Soviets to believe that we simply will never deploy mobile ICBMs, and, therefore, that they do not need to take account of such a prospect in the positions they take in the START talks.

We have spent enough time debating this question. The President's program is a thoughtful, logical, answer to what has often seemed to be an intractable set of issues. Our program deserves the support of the Senate, and of the entire Congress, and I would urge the Committee to support it and the other elements of the strategic modernization program.

Senator EXON. Mr. Secretary, thank you very much.

Before I recognize General Welch, I would like to recognize Senator Thurmond, as I indicated earlier, for any opening statement you might have.

Senator THURMOND. Thank you, Mr. Chairman.

Over the past decade or more the ICBM program has been one of the most contentious strategic force modernization issues facing our country. Yesterday, the President met with congressional leadership in an effort to form a bipartisan consensus on the funding of a mobile missile ICBM program that includes both the Peacekeeper Rail Garrison and the road mobile Small ICBM.

The meeting appears to have been a success. Both Republicans and Democrats alike have spoken favorably about the outcome of the meeting.

In years past I have gone on record as preferring the MX missile over the small mobile ICBM; but if we are to end this seemingly protracted and internecine debate over ICBM modernization, I believe we must seek a bipartisan consensus on how a two-missile program should proceed. I believe President Bush may have achieved that consensus.

While I am still a strong proponent of the Peacekeeper Rail Garrison program, the small, road mobile ICBM does offer some important political and military advantages, and therefore warrants our support. In the end, the development of the Small ICBM may be in the best interest of the country. Among other things, it will ensure that the United States has in production a new ICBM for the 21st century. Additionally, as the United States begins to reenter negotiations to reduce strategic nuclear weapons, it is imperative that the country demonstrates a solidarity by supporting the President's strategic modernization program.

The history of arms control has shown that the United States must bargain from a position of strength. Otherwise, the Soviets have little incentive to negotiate seriously. A two-missile program will give the United States both strength and flexibility in negotiations with the Soviet Union.

My support for the President's strategic modernization program is contingent, however, upon continued funding of the Strategic Defense Initiative, or SDI program. The funding of a two-missile program and a robust strategic defense system is critical, in my opinion, to the maintenance of a strong and credible deterrent force.

I know the President would agree with my position. It is my hope that negotiations on strategic force reductions will also pave the way for the United States to begin deployment of defenses that will protect the American people and our military forces.

I welcome the witnesses before the committee, and I look forward to their testimony. I am sure they will provide us with an informed assessment on how we should proceed with the present proposed ICBM program.

Thank you, Mr. Chairman. I am going to yield now to the able Senator from Maine.

Senator EXON. Thank you very much, Senator Thurmond.

General Welch.

STATEMENT OF GEN. LARRY D. WELCH, USAF, CHIEF OF STAFF, U.S. AIR FORCE

General WELCH. Thank you, Mr. Chairman.

I would just add a few points of emphasis to Mr. Wolfowitz's comments. He has already discussed the two fundamental strategic nuclear deterrent tasks required to underwrite our strategic nuclear deterrent strategy: the first, to ensure that our day-to-day alert forces provide high confidence that our retaliatory capability is so credible and so visible that no potential enemy could think they could gain from a surprise attack. Given the improvements to the U.S. strategic deterrent force from the efforts of the past 10 years, well supported by this committee, we have that high confidence deterrence of a surprise attack today.

The second task is more difficult, and that is to provide stability in a crisis. And that task requires a capability to increase the alert forces and increase their survivability so that the deterrent grows faster than any temptation to attack that might come out of a crisis. And, of course, that is the issue today.

To meet those two needs, and at the same time the need to minimize damage if deterrence fails, we are seeking your continued support for strategic modernization programs that provide adequate and affordable day-to-day alert forces 365 days a year for decades to come, and a force that can also rapidly expand its flexible response capability and its survivability in a crisis. In addition, I think it is important to note that that triad of strategic forces must, in the aggregate, provide assurances of continued robust capability in the face of possible future Soviet improvements, and those forces must also be compatible with sensible and verifiable arms control agreements.

You have before you a combination of strategic modernization programs that fill those needs. And I would spend just a moment on two specific issues, and that is mobile ICBMs and the B-2 bomber.

It is no secret that I strongly believe that land-based mobile ICBMs contribute greatly to stable deterrence; and I strongly support the plan forwarded by the President to achieve that capability. And from the arms control viewpoint, we must also bring the Soviets to agreement on a mobile deployment approach that lends itself to adequate verification.

The first available improvement to the ICBM force is clearly to rebase the existing 50 silo-based Peacekeeper missiles. I find there is widespread agreement that we would much prefer those existing missiles be rail mobile, and we should move on with that without further delay.

But while that greatly increases the flexibility of those 50 missiles, and adds survivability in a crisis, and contributes to stability, it does not add any new, high quality warheads to the deterrent force. Continuing development of the Small ICBM for planned deployment in 1997 does add high quality warheads in a deployment mode that provides maximum operational flexibility, and that combination is also highly resilient to possible future technological advances.

So it is the right combination of approaches. It maintains a robust, land-based ICBM leg of the triad. It adds significantly to deterrence, and it does so in a fiscally responsible manner by phasing the two programs so that they are both affordable and properly paced.

As to the B-2, I am much concerned about the growing focus on cost without corresponding focus on value. The development of revolutionary new technologies for the B-2 will provide a stream of benefits for new systems that stretches far into the future, and further, some 75 percent of the development funding to do that is already invested.

Based on current production cost projections, the flyaway cost of the B-2 will be only about 20 percent more than what we paid for the B-1, and for that relatively modest increase in the price we pay for the B-2, with its revolutionary capabilities, it promises to provide the most efficient and effective approach to covering a very large class of Soviet targets and is essential to future deterrence. Considering its very large contribution to stable deterrence, it is by any measure a good buy for national security.

Mr. Chairman, I look forward to the committee's questions.

Senator EXON. General, thank you very much. Let me start out by asking this question of both of you.

SMALL ICBM

One of the controversies that has surfaced from time to time with regard to the Small ICBM is whether it will have one or two warheads. One time it was up to three; now it seems to be back down to one.

Has a firm decision been made as of this date as to the number of warheads that we will place on the Small ICBM, when and if we get it built?

General WELCH. The missile that is currently under design is a single warhead, 37,000 pound missile. That missile would accommodate a two-warhead configuration, if we should decide that makes operational and economic sense. But the current design is a single warhead, 37,000 pound missile, Mr. Chairman.

Senator EXON. It would carry two?

General WELCH. That design would accommodate, with some operational restrictions, a two-warhead version, if we were to decide that makes economic and operational sense. More specifically, if we were to put two warheads on a 37,000 pound missile, we could not operate it from southwest basing because of range limitations. It would have to operate from Minuteman sites in the northern tier.

Senator EXON. Mr. Secretary, do you have any comment on that?

Mr. WOLFOWITZ. I agree with everything the General said. We are looking at a range of possibilities, Senator, and we have not made a final decision.

Senator EXON. I would just caution you that if we put more than one warhead on that Small ICBM, it looks to me like we are going to be right back into the argument, which I think has fueled the flame on the 10-warhead system, and that is that we should have never gone to a multi-warhead system to begin with. I do not happen to agree with that philosophy, but I just warn you that that is a problem that I think we might run into.

RAIL GARRISON MX PROGRAM

General, the GAO earlier this year criticized the Air Force's Rail Garrison MX program on the grounds of excessive concurrency. One of the major complaints was that the Air Force will have bought all 50 trains before, before there is a test launch of the MX missile from a railcar launcher. Is this true?

The Air Force, I gather, disagrees with the GAO's conclusions. Would you explain in detail the Air Force's position on the GAO report?

General WELCH. Yes, I will. Of course, the missile exists. Zero risk associated with that. The command and control system exists. The missile was initially designed, as you know, to be fired from that kind of a vehicle, and the risk associated with returning that missile to that kind of a vehicle and going through the test program is normal; and we feel that there is adequate time in the program to prove out and conduct those tests.

We are certainly not concerned about the risk associated with building the railroad cars. We build railroad cars of that general capacity today, and they are running on the rails every day. So, given the length of time that we have been involved in this overall concept and all the effort that has gone into this concept, I am not concerned with the concurrency in the Rail Garrison program.

Senator EXON. Are you saying then, General, that if we were going to try to do this with a Titan missile, for example, we could have a potential problem, because the Titan was not designed to so launch, whereas the opposite is the case with the MX?

General WELCH. Quite possible. But, as you know, from the outset we have done endless years of study on exactly this kind of operation for this missile.

Senator EXON. Following up on the issue of concurrency, General, if we were to ask the GAO to look at the revived and revised Small ICBM program with the $947 million that Secretary Cheney has added, and the IOC of 1997, would the GAO find cause to claim too much concurrency in that program also? Would that necessarily follow?

What is your opinion? How concurrent will the Midgetman program be in comparison with the Rail Garrison MX program?

General WELCH. Well, I would be reluctant to forecast what the GAO might say, but I can certainly give you my opinion.

Senator EXON. I wanted to give you a chance to say that.

General WELCH. I think that the Small ICBM program, as it is laid out, with the addition of the $947 million, is a very well-paced program. As you know, the original budget that was submitted covered the development of the missile and the testing and the certification of the missile. That program has not changed, that schedule has not changed, and that funding has not changed.

The $947 million adds the funding, beginning in 1992, to restart the basing work, and that also is well paced. So I believe it is a well-paced program.

NUCLEAR WAR

Senator **Exon**. Mr. Ambassador, most experts seem to believe that if we were ever to get into a nuclear war with the Soviets that the triggering mechanism would be some grave crisis, probably a clash between the Soviets and the United States in the conventional area, that might escalate into a nuclear exchange. Do you agree with that view?

Mr. **Wolfowitz**. Senator, I guess I would agree with the view that that scenario seems to me far and away the most likely way things could happen, but I would also emphasize that I think history is just strewn with examples that wars tend to start in the ways that people think are not the most likely way. And I think that it is important that—this is not only in our nuclear planning, but in general—we not pick one specific threat and then deal with that and forget about all the others. I think we need a balance across a range of threats.

Senator **Exon**. Well, if that is true, does it not follow then that under almost any imaginable scenario, we will have days or weeks at least of strategic warning during which we can bring our nuclear forces to full, dispersed alert?

Mr. **Wolfowitz**. I would not say any imaginable scenario, Senator. I would say under most scenarios that seemed worrisome we would have time to generate our forces. And large portions of our existing triad depend on exactly that kind of opportunity to generate them. Large portions of our SSBN force and our bomber force would require generation in order to become survivable.

So we build that assumption into our force today, but at the same time, we do not want to open up an opportunity for someone to say oh, well, then precisely the way to attack the United States is to avoid giving that kind of signal. And, in fact, we have plenty of deterrence on a day-to-day basis as well.

Senator **Exon**. Thank you. My time is up.

Senator **Thurmond**. Mr. Chairman, if agreeable, could I yield to the distinguished Senator from Maine? He has got to leave.

Senator **Exon**. Senator Cohen.

Senator **Cohen**. Thank you very much, Mr. Chairman.

MIDGETMAN

Could I inquire, taking into account Secretary Cheney's recent decision to increase the FYDP for the Midgetman, what development and testing objectives are going to be accomplished in the fiscal years 1990 and 1991 under this new funding profile?

General **Welch**. As I suggested at the outset, sir, all of the 1990 and 1991 work, plus the work that will be done with the reprogrammed $100 million from 1989, is associated with the development and certification of the missile. I have some——

Senator **Cohen**. I know, but what testing is going to be done that would not have been done under the original proposal that was submitted to the committee.

General **Welch**. What does the $947 million add?

Senator **Cohen**. What do you intend to accomplish during the 1990–1991 timeframe, and for the rest of the FYDP for that matter? There has been considerable skepticism on the committee as to whether the administration was, in fact, committed to the Midgetman system, and I am wondering what will be given or what will be achieved during 1990 and 1991 that would not have been achieved under the administration's prior proposal.

General WELCH. Under the administration's prior proposal, there would have been no activities in 1990 or 1991 associated with the Small ICBM. The program would have been terminated. So what the new profile does, the profile——

Senator COHEN. Excuse me. The program would have been terminated under the original proposal coming from the administration?

General WELCH. No, sir. Before the administration made their proposal. Are you asking what does the $947 million add?

Senator COHEN. I am asking, what change is going to be accomplished under the new funding profile of this $100 million that has been added.

General WELCH. Okay.

Senator COHEN. What testing objectives will be achieved?

General WELCH. The profile submitted by the administration, which was $100 million in 1990, $200 million in 1991, and $100 million reprogrammed in 1989 from the MX to the Small ICBM, is the lead-in funding for those 3 years that fully develops, fully tests, and fully certifies the Small ICBM missile for 1997 IOC.

Now, what has changed, what Mr. Cheney sent over in his new letter, was the funding beginning in 1992, which would fund the hard mobile launcher and the other aspects of basing that were not funded in the original. So the original submission fully funded the missile development. It did not fully fund the basing development, the hard mobile launcher, et cetera.

SOVIET SS-24

Senator COHEN. General, would you agree that of the Soviet Union's two mobile missile forces, the SS-24 is the more difficult to monitor?

General WELCH. No, I would not.

Senator COHEN. You would not. Would you agree that the SS-24 is a greater military threat than the SS-25?

General WELCH. No, I would not.

Senator COHEN. Would you agree that the SS-24 poses a greater breakout threat than the SS-25?

General WELCH. That's a more complex question. It does not lend itself to such a short answer.

There are those who believe that if you miss one 10-warhead missile, you obviously missed 10 warheads, and they believe that it is more likely that you will miss one 10-warhead missile than 10 one-warhead missiles. And quite frankly, I do not know the answer to that and neither does anyone else.

Senator COHEN. You mean to say that you disagree with the proposition if you miss one single warheaded system compared to one 10-warheaded system that you are about equally bad off?

General WELCH. No, no. I did not say that.

Senator COHEN. Is that what you are saying?

General WELCH. What I said is that it may be far easier to keep track of a 10-warhead missile than it is to keep track of 10 one-warhead missiles. And no one knows the answer to that question, so I do not know whether verification is more difficult for the single warhead missile that has the freedom to range in wide areas than it is for a seven- or eight-car railroad train that you know at least is going to be on a railroad track.

And I am not saying that one is easier than the other. I am saying that I do not know, and neither does anyone else. But I do know that we have far more experience at this point in time in monitoring the SS–25, because it has been deployed much longer, and we have watched the Soviet operations for much longer. So there is a higher degree of comfort that we understand how they deploy the SS–25 in peacetime.

We have just begun to observe the operation of the SS–24, because it has not been deployed that long. So we are less comfortable about our understanding of how they will operate the SS–24. But I would hasten to point out I would not take too much comfort from either one by watching what they do in peacetime.

STRATEGIC MODERNIZATION PROGRAM

Senator Cohen. Last July the Defense Science Board was tasked to study the strategic modernization program, and there were some reports in the press that the task force recommended that if the MX is put on railcars under a Rail Garrison concept, that some of the MXs ought to be deployed on those rails at all times. Do you agree with that?

General Welch. I agree you have the option to do that anytime that the level of concern warrants doing that. I do not agree that you need to do that on a day-to-day basis under the conditions we have today or the conditions we are likely to foresee. I think if you would ask today this whole roomful of people if anyone thinks we need to take any special actions at this moment to prepare for the possibility of a Soviet attack, everyone would say no.

Senator Cohen. Well, no one is asking that question, General, but it seems to me a complete reversal of the position that was advocated for so many years before this committee by the Air Force of a need to have a mobile MX.

General Welch. The Air Force continues to advocate the need for a mobile MX. I do not advocate the need that it be out on the rails every day in a mobile mode. We have to constantly have the capability to deploy, to disperse on the rails anytime the level of concern would warrant doing that. That is a mobile MX.

B–2

Senator Cohen. General, I just want to touch briefly—my time is about to expire—on the B–2. You indicated that the B–2 was only 20 percent more expensive than the B–1. I think you have eliminated any R&D costs—we put about $20 billion in that—and you are talking about flyaway costs only.

Let me say that there are a couple of things that trouble me about the B–2, and I have not made a decision on it. But two arguments are not going to be persuasive to me. One is that it only costs 20 percent more than the B–1. I think we paid too much for the B–1, and we got too little in return. So the argument that it only costs 20 percent more is not going to be particularly persuasive with me.

I am reminded of Norm Augustine's book that he wrote called "Augustine's Laws," in which he predicted, somewhat tongue in cheek, that by the year 2020 we may spend the entire defense budget on procuring a single aircraft. And when we were talking about procuring an aircraft that costs a half a billion dollars apiece, I think Augustine's laws are coming more closely into focus.

Second, I would point out that last time I believe you stressed—not you, but it has been stressed by others—the conventional capability of the B-2. That also is not particularly persuasive to me. It is the equivalent of saying we are going to send a Rolls Royce down into a combat zone to pick up groceries. I do not know that any military leader is going to be sending a B-2 out on a conventional mission. It is unlikely that they will do so.

The fact that it has the capability, I mean that stands for itself. But the likelihood of its deployment in a conventional role is highly unlikely.

But I still have not reached a decision on B-2, but those two arguments are not going to be persuasive.

Thank you very much, Mr. Chairman.

Senator **Exon**. Thank you, Senator.

Senator Gore.

Senator **Gore**. Thank you very much, Mr. Chairman.

I appreciate the testimony we have heard this morning and also the move by the Secretary of Defense in recent days to send a new message to the Congress about requests for additional money for Midgetman. I was also glad to see the reports of the discussion in the White House yesterday in which the President expressed such strong support for a bipartisan package, including two missiles.

I continue to believe that it is a mistake for the United States not to approach the arms control talks that opened this Monday with a new position after a 6-month strategic review, and I think that position should be based on a solid strategic rationale. That rationale can be found in the movement of funds toward Midgetman and can be inferred from the overall approach which seems to be developing, but there is an unnecessary risk still being run in the Congress because of the lack of any clear statement of the strategic rationale involved. That is not a matter for these two witnesses, but I did want to say that at the outset.

SMALL ICBM

General Welch, let me ask you a few questions about the Small ICBM. First of all, I note in the prepared statement of Secretary Wolfowitz the addition of the "bolt out of the blue" scenario as a second rationale for the modernization program. It has traditionally been part of the rationale, and I would like to ask you, General Welch, to elaborate on why you believe it should continue to be something of concern, even though it is objectively unlikely in the extreme.

General **Welch**. Well, I think, as we have discussed before, a surprise attack is not inherently irrational; you make it irrational by ensuring that we maintain the peacetime, day-to-day alert forces that makes the price they pay for a surprise attack too much to contemplate. And it is important that as time goes on we continue to ensure that our day-to-day alert forces meet that criteria.

I believe they do today, with great confidence, and I believe the program we have laid out will ensure that they do for the foreseeable future.

Senator GORE. I appreciate that response, and I think it is a very important one. I would add one further element. I think a study of the arms race indicates that even hypothetical first strike advantages have tremendous geopolitical significance. Would you agree with that?

General WELCH. Absolutely.

Senator GORE. Would you agree with that, Secretary Wolfowitz?

Mr. WOLFOWITZ. Yes.

MX

Senator GORE. In fact, some of those who most strongly favor the MX, as opposed to the Midgetman, if they had their way, would immediately follow up that strategic move by the United States with a renewed effort to deploy an SDI program as quickly as possible, precisely because the fear of a first strike would not have been removed by the deployment of the MX. I think the package that has been developed here, which was articulately endorsed by the ranking Republican member of the committee, does in fact make sense. And I agree with the outlines of the statement by the Senator from South Carolina.

Now, could you address the baseline cost, General Welch, of the Small ICBM, because we still continue to hear some of these inflated estimates from some people. And actually, if you pay close attention to what the Air Force has done in the early stages of this program, there have been some significant changes in the numbers that we should look at; is that correct?

General WELCH. From the estimates earlier in the 1980s, the estimated cost or the projected costs of the Small ICBM have been significantly reduced, yes, that is true.

Senator GORE. What baseline figure should we be looking at now?

General WELCH. Well, we have to figure out which year we are talking about. I think that—let me get you 1989 dollars. In 1989 dollars, the complete Small ICBM total program costs $28.3 billion.

Senator GORE. Twenty-eight point three for the—that is the entire——

General WELCH. That is the complete——

Senator GORE. That includes the operating costs, correct?

General WELCH. No, no. That is the acquisition cost.

Senator GORE. All right. That is the acquisition cost over what period of time?

General WELCH. Well, that would run out through the 400 or 500 missile program, which would run out beyond the year 2000. The total cost to complete the Small ICBM, in 1989 dollars, is $24.9 billion.

Senator GORE. All right. That contrasts with the earlier figure of $50 billion to $60 billion, correct?

General **WELCH**. Well, you know, $50 to $60 billion was loosely bandied about. What was in the program was $40 billion.

Senator **GORE**. All right. But it has come down from that $40 billion——

General **WELCH**. That is correct.

Senator **GORE** [continuing]. Which was inflated by some opponents, but it has come down from the $40 billion to $28 billion.

General **WELCH**. That is right.

Senator **GORE**. And what is the difference between the $28 billion figure and the $24 billion figure that you just used?

General **WELCH**. Cost to complete.

Senator **GORE**. Cost to complete. All right.

General **WELCH**. Twenty-eight point three is the complete program cost; $24.9 billion is the cost to complete, both in 1989 dollars.

Senator **GORE**. Now, a second point has to do with the sequentiality. Is this an important new element in the Air Force's calculations about how to solve the conflicting equations on funding?

General **WELCH**. It has to do with affordability, yes, sir. The sequence itself is dictated by technical considerations, obviously; the Peacekeeper being here in existence and can be completed with an IOC in 1992, while a Small ICBM, by nature of the technical phase-in of the program, is somewhat later. But the 1997 IOC was selected in order to sequence these programs in an affordable manner.

Senator **GORE**. In conclusion, Mr. Chairman, let me just say that I think we have seen an important move by the administration. I believe a strategic rationale is still needed, but we have seen important progress.

If we are to serve the public interest well, we will proceed simultaneously with arms control and modernization, with programs both in the United States and the Soviet Union which push the relationship between the countries toward a stable equation in which neither side can gain an advantage from a first strike.

Thank you very much.

Senator **EXON**. Thank you. Just a quick follow-up question on that, General.

PROTOTYPE COSTS

I can understand, with the experience that we have had with missiles, and since the development stage of the Small ICBM is quite well along, how we could accurately estimate the costs of the missile. I get the impression that we have not yet begun to settle on the launcher, the land rover, call it whatever you will. That is still in the early stages of consideration—is that true?

General **WELCH**. Well, we have, of course, built a prototype, and have experience with the prototype. We have not gone into full-scale development for that system yet.

Senator **EXON**. Are you quite convinced that the cost of that prototype is adequately addressed in the figures that you just gave?

General **WELCH**. We have confidence in our figures, yes, sir.

Senator **EXON**. Thank you. Senator Thurmond.

Senator **THURMOND**. Thank you, Mr. Chairman.

FUNDS FOR SMALL ICBM

General Welch, the $100 million requested for the Small ICBM in fiscal year 1990 may not be enough to keep the program healthy.

Secretary Cheney has now requested a reprogramming of $100 million for 1989.

Assuming that most of these funds will be spent in the fiscal year 1990, will this be enough to keep the program healthy?

General **Welch**. Yes, it will Senator. When the profile was laid out to complete the development, the certification and the testing of the missiles, we assumed the use of $100 million of ICBM money in 1989.

Subsequent to that, we came back for the reprogramming of that money within the ICBM line, but that was assumed when the original profile was laid out.

Senator **Thurmond**. General Welch, I was pleased to see that the Secretary has proposed to increase funding for Small ICBM basing. But the added funding is in fiscal year 1992 to 1994.

My question is about the funding for fiscal year 1990, a $100 million. In fiscal year 1991, $200 million. Can you assure us that the program risk is manageable at this level of funding?

General **Welch**. I have no reason to believe otherwise, Senator. We are content with that funding profile.

Senator **Thurmond**. General Welch, Secretary Cheney proposes to add $947 million in fiscal years 1992 to 1994, for the Small ICBM basing. From which programs will this money come?

General **Welch**. That has yet to be addressed. That will be addressed in the 1992–1993 budget submission, and we have not worked the details of where that money comes from at this point in time.

BASING OPTIONS FOR SMALL ICBM

Senator **Thurmond**. General Welch, one of the basing options for the Small ICBM is to base the missile on trucks at military reservations in the southwest, I believe. Will the system still be able to reach the required targets in the Soviet Union from those bases, and will you be able to include penetration aids?

General **Welch**. Yes, sir. The 37,000 pound, single warhead missile can reach all of its target base from southwest basing, and carry penaids.

Senator **Thurmond**. Thank you.

SHORT-RANGE NUCLEAR WEAPONS

Secretary Wolfowitz, I have one question for you. Despite the obvious need, some of our European allies have voiced opposition to the modernization of our short-range nuclear weapons.

I have seen little in the press regarding the European nations position on the strategic arms reduction talks. What are the positions of the British and German Governments regarding the strategic arms reduction talks? I am specifically interested in their position on mobile and multiple, independent, reentry vehicles.

Mr. **Wolfowitz**. I would say, broadly speaking, Senator, they are very supportive of the START process. I think they strongly hope that we will succeed in achieving an agreement with the Soviet Union that advances our security.

Although we consult with them closely, by and large they have really deferred to our leadership on questions like the one you asked about. I think they would say that whatever the United States judges to be the strategically most effective posture is one that we will support.

Senator **Thurmond**. Thank you very much. Thank you, Mr. Chairman.

Senator **Exon**. Thank you, Senator Thurmond. Senator Nunn.

SOVIET PREEMPTIVE ATTACK

Senator **Nunn**. Mr. Chairman, first, Mr. Wolfowitz, you mentioned twice in your statement—I am not sure exactly—well, one word is on page 3, at the top of page 3 you talk about Soviet preemptive attack. And over on page 2 you talk about a preemptive attack.

Are you using that word, "preemptive", synonymous with what we would call a first strike?

Mr. **Wolfowitz**. Yes, I believe so, Senator.

Senator **Nunn**. Is it synonymous with what we have been terming "bolt out of the blue?"

Mr. **Wolfowitz**. No, not necessarily. Not at all. You could have a preemptive attack in the middle of a conventional war in Europe.

Senator **Nunn**. We are talking, but—so first strike would more nearly be synonymous—those two terms were, are interchangeable.

But "bolt out of the blue" is something different. "Bolt out of the blue" is something that comes without any confrontation. Just bang, one day they get up and start firing. Is that right?

Mr. **Wolfowitz**. That is right.

Senator **Nunn**. The reason I ask is, the word "preemptive", in the way it has been used historically, is that someone launches an attack right before someone else was about to. And I wonder if that is the word you wanted to use in that context?

Maybe I am not reading it correctly, but that is my understanding of preempt—is that you think the other fellow is about to launch, and, therefore, you hit him first. Which indicates that what we are talking about here is the Soviets thinking we are about to launch and hitting first. It is a little bit different connotation to me than first strike, but maybe I am overreading it.

Do you mean it to be different—that is what I am asking?

Mr. **Wolfowitz**. Senator, I will go back and focus on the precise use of that word—your point is absolutely correct about the implications of "preemptive." It is one kind of a first strike. And I think, in fact, it is one kind that a lot of attention is paid to—a first strike that comes out of a fear an attack is coming, or that the war is inevitable and you might as well have the advantage of preempting—of going first.

Senator **Nunn**. But first strike would be a little broader than that?

Mr. **Wolfowitz**. It is broader than that.

Senator **Nunn**. It could include preemptive, but it could include something that was not preemptive—that was simply emptive, if there is such a word.

Mr. **Wolfowitz**. Absolutely. And we are interested in deterring all forms of attack on us, not just preemptive ones.

DETERRENCE

Senator **Nunn**. It seems to me, Mr. Wolfowitz, you have said something—you and General Welch have said something very important here today. Maybe it is a change, maybe it is not. But at least to me it is a clarification.

On page 3 you say, "While it is important that we have adequate deterrence against both of the above scenarios, we are proceeding sequentially," and so forth. And those two above scenarios are both the "bolt out of the blue" and a strike arising out of an intense crisis.

So what you are saying is that our land-based deterrent missile program, the President's proposal, is now being designed basically to have adequate deterrence against both a "bolt out of the blue," as well as a strike rising out of a crisis.

Mr. **Wolfowitz**. That is correct. Emphasizing it is our deterrent posture as a whole that we really are looking at, and we have, we believe, strong and adequate deterrence, looking at the force as a whole against both of these scenarios today.

What we do not have today is——

Senator **Nunn**. But you said you want some survivability in each leg of the triad?

Mr. **Wolfowitz**. Yes, if we can get it.

Senator **Nunn**. And you designed these two potential scenarios against the ICBM silos. So putting all that together, it seems to me you are saying each leg of the triad should have some survivability against both of those scenarios?

Mr. **Wolfowitz**. That is our goal. Yes, Senator.

Senator **Nunn**. And then taken as a whole, you get even more survivability. But that is the way I read your statement.

Mr. **Wolfowitz**. Correct.

SURPRISE ATTACK

Senator **Nunn**. General, you said in answer to Senator Gore's question, that surprise attack is not inherently irrational. Are you using surprise attack there as synonymous with, say, what I call first strike, or "bolt out of the blue?"

General **Welch**. I am using it synonymously with "bolt out of the blue." That is correct.

Senator **Nunn**. You went on to say that what makes a "bolt out of the blue" attack irrational is our ability to deter it?

General **Welch**. That is correct. Yes, sir.

Senator **Nunn**. I think those statements are very important, and I am personally pleased that you have made it very clear what the administration's program is on that. I think it will help in addressing these questions, when the inevitable challenges come up.

U.S. POSITION ON MOBILE ICBMS

Secretary Wolfowitz, President Bush has now pledged to review the U.S. position on mobile ICBMs in the START negotiations. He made this very clear yesterday, once he has ascertained that there is sufficient support in the Congress to fund both the MX Rail Garrison and the Midgetman missiles—what, in your opinion, will be required to demonstrate that kind of congressional support?

Mr. Wolfowitz. I think, obviously, voting to support the programs now before the Congress is one of the most important, single demonstrations that we could have.

Senator Nunn. Well, certainly, it would include authorization and appropriation cycles this year.

Mr. Wolfowitz. Absolutely. And I think it is a critical test, and I think everyone, is going to view it that way.

5-YEAR SMALL ICBM

Senator Nunn. General Welch, is the Air Force on board completely with the plussing up that has now been done by Secretary Cheney on the 5-year budget for the Small ICBM?

General Welch. Yes, sir. I say that with some trepidation in that as I said in the answer to Senator Thurmond's question, we do not yet know where that money is coming from, but we assume that we will have a good bit to say about where that money comes from—if it comes from within Air Force programs.

But if the question is really, is the Air Force committed to the Small ICBM, the answer is yes.

Having looked at the entire flow of funds required to sequentially address both these programs, we are committed to that.

Senator Nunn. There are some other questions about where the money is coming from for other programs in the 5-year plan, are there not?

General Welch. Absolutely.

Senator Nunn. So this is not, necessarily, the only place that we have question marks about how we are going to fund all the 5-Year Defense Plan, including Air Force?

General Welch. Quite so.

Senator Nunn. Are you personally in favor of the Small ICBM now, as outlined by President Bush?

General Welch. Yes, I am.

SOVIET SS–24S AND SS–25S

Senator Nunn. I was a little bit surprised, General Welch, to hear you say that no one really knew as to the difficulties of verifying SS–24s versus SS–25s. I had understood, and maybe I am wrong on this, that the intelligence community at this stage—I am not saying, necessarily, the long term, was having more difficulty with the 24s. Is that an erroneous impression?

General Welch. No, I think that is correct. I think the reason for that—your intuition would tell you, it is easier to keep track of seven and eight-car trains than it is trucks that can run around in the woods. That has not been the finding of the intelligence community.

I think the reason for that is that the Soviets have followed fairly longstanding, predictable patterns in the way they operate the SS-25 in peacetime. And we have been observing those patterns for some time. That makes it much easier for us to continue to observe those activities.

Whereas, in the case of the SS-24, it has actually been deployed on the rails for only a short period of time. We are learning a great deal more about it every day as we get what information we can about those patterns of operation. But we do not have a long record of watching those patterns of operation, and we just do not know that much about how they are going to operate the SS-24.

So there is that marked difference in what we know about how the Soviets use the two systems.

Senator NUNN. Mr. Chairman, may I have one more question?

Senator EXON. Go on ahead, Senator.

VERIFICATION

Senator NUNN. Mr. Wolfowitz, the President has tabled or proposed at Geneva now, certain—I would call them pilot project-type verification ideas. Are those ideas generally aimed towards verifying things that have already been agreed on tentatively between the two countries, or are they aimed at ideas like mobility, and how you verify mobility? Ideas that have not yet been agreed on, or is it a combination?

Mr. WOLFOWITZ. It is a combination, Senator. Some of it is precisely in the things we have already agreed on, and some of it is aimed at trying to figure out solutions to the problem of verifying mobiles, which is one of the crucial things in coming to a final agreement on that issue.

Senator NUNN. Well, I just want to make it clear that, contrary to some criticism, I think that is a good idea. I think that it will save time in the long run.

I do not understand the logic of saying that you do not gain time by having some parallel effort on verification, when everyone knows—certainly here in the Senate, that will be one of the key questions on ratification.

So I believe that is a step in the right direction and I would hope that the critics of that would put it in that context. Because some of the criticism, it seems to me, to act as if verification is something that never is going to have to occur. And that all of these things are simply going to get in the way of the substance of the discussions which I do not see at all.

I would think that some of the substantive decisions in this very difficult area may very well depend on whether we can have some reasonable assurance of verification.

So I just wanted to go on record again that I believe that concept is important. And I would hope we could find a way to do it in conventional arms control too. Do some pilot projects as we are talking.

Mr. WOLFOWITZ. There is certainly some thinking along those lines going on, Senator. I appreciate your comment. I think if you treat verification as an afterthought that is a formula for delaying and possibly even subverting the whole process.

Senator **Nunn**. Right.

Thank you, Mr. Chairman.

Senator **Exon**. Thank you, Senator Nunn. Senator Wallop.

Senator **Wallop**. Mr. Chairman, thank you.

COMPLIANCE

Let me just say—Senator Nunn, I quite agree with you too. I would go one step further and hope that at least in this administration there was some purpose in mind for compliance, because without compliance, verification is a useless exercise.

If you verify they are not complying and then do nothing about it, you really have not gained a hell of a lot. And that has been our pattern. That was the pattern of the administration in INF. We refused even to contemplate an advisory paragraph to which the Soviets need not have signed on at all.

During the administration, subsequent administration, if we had problems with compliance, the President would report to them—to us about them, and suggest means of addressing them. It was pretty innocuous, and defined them in absolute and total opposition to that concept. There was no confidence as to what we might find as our purpose in the future.

General Welch, I have always been a strong supporter of ICBM modernization, and in particular, the MX program. That is no surprise to you, I think.

My own view on the Small ICBM is that we need to maintain the missile for a possible replacement of the Minuteman II and III, near the turn of the century, depending on a lot of things. And especially in that world where we contemplate there might be fewer strategic weapons on assignment. And the small, revamped ICBM affords us the opportunity to proliferate aim points quickly and cheaply.

But in my judgment then I am seeking a comment on this, the Air Force took a perfectly good idea, which was the small, cheap austere missile, and turned it into a clone of MX—a bigger, more expensive, and relatively inflexible missile, as it is presently configured.

And I think one of the reasons, it is having trouble is that it is a very expensive solution to a vulnerability problem.

I wish we could get someone in the Air Force, other than General Piotrowski, interested in defense, as an alternative, or as an adjunct to the vulnerability problem.

AIR FORCE VIEW OF ICBM

Can you tell me, as we look beyond the redeployment of the 50 MX to Rail Garrison, where the Air Force sees the ICBM force going, and what are the plans for Minuteman upgrades? And do we currently plan to keep the force viable beyond the year 2000?

General **Welch**. As you know, we certainly do plan to keep a number of Minutemen viable for years to come. As to exactly what that force will look like, it will be impacted to some degree by the arms control negotiations—with a little bit of the which comes first, the chicken or the egg situation—in that we have not defined precisely which choice we would take on this force structure coming out of the START agreement, although we have many options.

But commenting only on the Minuteman, there are several possibilities. One is there may be no agreement, in which case the Minuteman will stay pretty much as it is, with continued upgrades to extend its life.

Eventually, we will have to replace it. But the money we have in the FYDP, for example, extends the life of the Minuteman force well beyond the middle of the next decade—well beyond that. I cannot go any further than that in an open hearing.

Even if we do, and I should not say it that way, because I expect this to come to pass, assuming that we do reach a START agreement that we are all happy with, then the Minuteman still has a role. It might be a reconfigured Minuteman, but the Minuteman still has a role for some years to come. It is for that reason that we are asking for the funds to ensure that we maintain a robust, healthy Minuteman force.

ARMS CONTROL DECISIONS

Senator **WALLOP**. It is hard for me to conceptualize waiting on arms control decisions—the form and shape of which cannot be predicted, even though the purpose may be clear in our minds at the moment.

And the problem with waiting to see how that turns out is that after it has, or has not turned out, you are so late in the game in trying to move, it would seem to me that investment is cheaper in both time and money, to proceed on the assumption that we need the strategic concepts in place until it is demonstrated clearly that we do not any longer, rather than the reverse. And saying our hope is, that it will be demonstrated that we do not, and so we are going to wait and see if our hope comes true.

General **WELCH**. I agree absolutely with you. Of course, that is the path we are proceeding on. We are proceeding to maintain and upgrade the reliability and maintainability of the Minuteman force because, with or without START, we are going to have some Minutemen. We are proceeding with the work required.

Now, what we do not know at this point in time is exactly how large that force will be, or what its configuration will be. We do know that we need the basic upgrades to the launch control facilities and to the missiles to maintain their health for a number of years to come. And that funding is in our budget.

MIDGETMAN

Senator **WALLOP**. Is there any chance of returning, in some measure, to the original concept of Midgetman, which was a very austere weapon, not merely so sophisticated and expensive as the present one?

General **WELCH**. Well, of course, the original concept was a replacement for Minuteman. I do not know that there is a lot of difference in the missile. The fact is that what makes the Small ICBM sophisticated is the requirement for accuracy. And I think there is not a great deal of difference in the missile. There is a great deal of difference in the deployment mode, but not the missile itself.

Senator GORE. Would the Senator yield briefly? Just before you arrived, he told us that the cost was now down from the $40 or $50 billion estimates to the $24–$28 billion level. And had talked about the size being right at the cutoff point. So that if it was MIRVed, there would be severe implications for the basing options.

So I think the overall thrust of what he is saying is, that it is at the smallest optimal size to carry penetration aids and to be based in a flexible way. And that the cost has been brought down to a point that is far below what the earlier estimates were.

So it may be moving in the direction that the Senator feels is wise.

Senator WALLOP. Mr. Chairman, my time is up.

Senator EXON. Thank you, Senator Wallop. Senator Levin.

MOBILE ICBMS UNDER START AGREEMENT

Senator LEVIN. Thank you, Mr. Chairman. First, Mr. Wolfowitz, on page 5 of your statement you have indicated that before permitting mobile ICBMs under a START agreement we wish to make certain that any limits on those systems were effectively verifiable.

As I understand it, the position that we are going to be taking at the START talks relative to mobility of ICBMs will be dependent on two things at least. One, whether or not the Congress appropriates money for both missiles, and second whether or not we determine that we can effectively verify limits on mobile ICBMs. Is that correct?

Mr. WOLFOWITZ. That is correct. Those are the two conditions. Our goal, Senator, is to have a regime under START where both sides can deploy mobiles with effective verification. That is what we are after.

Senator LEVIN. That is a change in our goal. Previously, our goal has been to ban mobiles. Is that correct? Is that the position we laid down at the START talks?

Mr. WOLFOWITZ. Well, there is a difference between tactics and goals. If we are talking about goals, I am not sure whether the earlier goal was to ban mobiles, per se, or to ban mobiles because of the verification problems they pose. Let me just talk about our goals——

Senator LEVIN. Was it our position that we ban mobiles before?

Mr. WOLFOWITZ. That has been our position on the table, yes.

Senator LEVIN. So in any event our goal is to change our position, now?

Mr. WOLFOWITZ. Our goal is to get an outcome that is different from our present position, yes.

Senator GORE. Will the Senator yield on that point?

Senator LEVIN. Not quite yet. At the end I would be happy to yield.

Senator GORE. Just for 10 seconds?

Senator LEVIN. Yes.

Senator GORE. The goal was to ban pending the negotiation of a verification regime. I think that is an accurate statement. I apologize.

Senator LEVIN. That is all right. I think he has answered the question. Our goal, or at least our tactic at that point, our position at that point, was to ban all mobile missiles.

Our goal now is to change that position—to find a way to change that position.

Mr. WOLFOWITZ. Senator, I guess what I am resisting is the idea of some radical change. I think the concern has always been first about verification and second about asymmetry.

CHANGE IN U.S. POSITION

Senator LEVIN. Forget the word radical. Is there a change in our position? I mean, let us be straight. Is there not a change going on here?

Mr. WOLFOWITZ. I believe that the principal concern has always been a concern about verification, as well as the concern that absent any program, we are talking about opening up a field in which the Soviets can do very well and we have nothing.

Senator LEVIN. Putting aside the concern, is there not a change in our position occurring?

General WELCH. I am trying not to dance on the head of a pin. Let me say it this way——

Senator LEVIN. Since you are not succeeding, let me move on to a different question. [Laughter.]

Is there a change—can you not give me a simple answer—going on in our position? If you cannot give me a simple answer I would rather, frankly, go on to a different question.

General WELCH. There is not a simple answer to that question.

EFFECTIVE VERIFICATION

Senator LEVIN. All right. One of the conditions here is effective verification, and assuming we can effectively verify a limit, my understanding is that it has been our plan to go for a limit on mobile ICBMs. Is that correct?

Mr. WOLFOWITZ. That is correct.

Senator LEVIN. Not for a ban?

Mr. WOLFOWITZ. Not for a ban.

Senator LEVIN. Whereas previously, if we could effectively verify mobile ICBMs it was our position to go for a ban. Is that at least correct?

General WELCH. The difficulty we are having with this, Senator, is that unless we can get adequate verification there is not going to be any kind of a treaty.

Senator LEVIN. I understand that, but my question, General, is this. If we could effectively verify before it was our decision we would go for a ban, whereas now, if we can effectively verify, it is our position to go for a limit. Is that not true?

General WELCH. No, sir.

Senator LEVIN. Mr. Wolfowitz, you have indicated that our position is going to be determined by both of those conditions—the congressional funding issue and the verification issue.

LIMIT ON MOBILE ICBMS

Does that mean, then, that until we know whether we can verify a limit on mobile ICBMs that we will not be putting down our position at Geneva even if we know before then that Congress is going to support both missiles?

It is really a two-step process here. If tomorrow, Congress authorized and appropriated the money, the bill were signed in this year's budget, but we have not determined whether or not a ban is verifiable, we would have to wait for that second step to be determined?

Mr. **Wolfowitz**. No. I do not think we are talking about waiting in that sense. We are talking right now with the kinds of proposals the President has just put forward at the opening of this round, about ways of improving verification and building greater confidence in verification methods, so we are not sitting around waiting.

Senator **Levin**. So our position on whether to propose a limit on mobile ICBMs is not going to wait until we can determine whether we can effectively verify such a limit?

Mr. **Wolfowitz**. Now, I think we are getting the cart before the horse, maybe.

Senator **Levin**. In other words, it is not going to wait?

Mr. **Wolfowitz**. Our position incorporates the idea of verification—our position that we want to count these things, if they can be effectively verified. That is our position. It is not going to change. We are working on finding the verification measures that will permit that to happen. Am I missing your question, Senator?

Senator **Levin**. Yes. It is okay, my time is up. Thank you.

Senator **Exon**. Thank you very much, Senator. I believe Senator Gorton was next.

Senator **Gorton**. In the current edition of "U.S. News & World Report" a column by Richard Perle includes the following statements on which I would like the comments of either or both of you, and I am quoting.

MIDGETMAN VERSUS MX

"The debate over Midgetman versus MX has come down to this: how much mobility at what cost is necessary to ensure that enough of our missiles would survive a Soviet attack? Those making recommendations to the President would do well to remember that sometimes we get a better answer if we ask a better question.

"The better question is, what is the best way to ensure, now and in the future, that our land-based missiles would survive attack in sufficient numbers to deter attack, and the better and the cheaper answer is that we should defend the missiles we already have, including the silo-based MX, rather than buy a new one, the Rail Garrison MX or the road-mobile Midgetman."

Is that statement as to "better and cheaper" correct, and is that the right question?

Mr. **Wolfowitz**. I believe, Senator, that it is not correct that that is the cheaper way to do it. I think what we have with this program is in fact—what was our judgment after careful review—the cheapest way to get survivability of our ICBMs.

Senator **Gorton**. General.

General **Welch**. I would agree. What we are talking about is price to attack, Senator, and it is—the mobile approach raises the price to attack virtually beyond the capability of the Soviets. The defense approach can raise the price to attack at some considerable cost to us, but I do not believe it is cheaper to depend on a defense over mobility for survivability of land-based missiles. It is cheaper to go mobile.

Senator **Gorton**. Cheaper, and more effective to go mobile, rather than to provide defenses? That is your opinion?

Mr. **Wolfowitz**. If you are looking at it narrowly from the question of ICBM survivability, yes. There is a much broader range of reasons why we want to have defenses, but not based on a single measure of ICBM survivability.

Senator **Nunn**. Senator Gorton, would you yield for just a brief follow-up on that?

Senator **Gorton**. Yes.

Senator **Nunn**. One of the premises of that article, I believe, and I read it a day or two ago and I have not refreshed my recollection, is the assertion in the article that the Midgetman program cost six times the MX and the price tag in that article—10 times the MX, I believe it is: $6 billion.

So there is a premise there that $60 billion is what the program is going to cost, when the testimony is it is going to cost between $24 and $28, so the basic assumption there is so far out of whack, it casts doubt on the rest of the article.

At least, that is the way I read it. Am I correct in that, General?

General **Welch**. Yes, sir. The cost differential is considerably smaller than was assumed in the article.

Senator **Gorton**. Thank you, Mr. Chairman.

Senator **Exon**. Senator Gorton has finished. Senator Gore.

Senator **Gore**. I have already asked questions, Mr. Chairman.

Senator **Exon**. Senator Warner, I believe.

Senator **Warner**. I am going to defer to one of my colleagues and come back in a moment, if I may. Thank you, Mr. Chairman.

Senator **Exon**. I lost track. Senator Coats.

Senator **Coats**. Thank you, Mr. Chairman. I just have a couple of very brief questions.

NATIONAL SECURITY POLICY

Mr. Wolfowitz, in your testimony you indicate that as we all know the administration has been engaged in a major review of the national security policy and you indicate that you have come to a number of conclusions.

I wonder—my question is, where are you in that review relative to not just the programs we are discussing here, but the entire question of deterrence with the triad? Is that review complete, or are these conclusions reached because of the budgetary process which Congress is undertaking, and obviously we are on our own timetable here.

How complete is the review? How satisfied are you that you have all the pertinent factors on the table to review in order to reach these conclusions? Are we getting the cart ahead of the horse? I guess that is my question.

Mr. **Wolfowitz**. No. In fact, we had completed that portion of the review before the President made his decisions on the ICBM program and the SDI program submissions to the Congress.

Senator **Coats**. Are there any outstanding criteria, variables, factors that you do not have relative to these programs that you wish you had, or that would round out or firm your conclusions, or at least raise other questions?

Mr. **Wolfowitz**. Not of the kind we would expect to get in the near term. Obviously, Senator, one always learns more each year, but the review process in this area is completed.

Senator **Coats**. Second, I am interested and would like to make sure I understand the timetables here.

TIMETABLES OF TRIAD

You presented two scenarios and in terms of the land-based portion of the triad, the deterrence factor for the land-based—you presented these two scenarios for the crisis attack and the "bolt out of the blue" attack and you determined that Rail Garrison is the proper deterrence for the crisis attack and that Small ICBM is proper for the "bolt out of the blue" attack.

I think you outlined the timetable for the Rail Garrison, but what is the timetable for the Small ICBM in terms of the IOC and then the completion of that?

General **Welch**. The IOC for the Small ICBM is 1997. The completion of the program depends on how many missiles we ultimately buy, but the 300 missiles which have been discussed, although that has not been settled on as the number, would take us beyond the year 2000.

Senator **Coats**. So we are anticipating end of the century before we have in place all the components necessary to meet the strategic policy conclusions relative to deterrence for the land-based portion of the triad. Is that correct?

Mr. **Wolfowitz**. Yes.

General **Welch**. It is a little stark to look at an end point like that. This is a continually moving evolution.

Senator **Coats**. I understand that, but as it is currently before us.

General **Welch**. Yes, that is true.

Senator **Coats**. Am I also correct in assuming—and I think you stated it here, but I just want to make sure I understand—that the determination was made that for successful negotiation under START it is important that—the President believes it is important that we demonstrate a commitment to go forward with both programs and that one of the factors in making that determination is bargaining leverage. Is that a correct assumption?

Mr. **Wolfowitz**. That is correct, Senator. I think I would say a little bit beyond that, too. I would say it is not only for effective verification, but to have a regime—a satisfactory regime at the end. We do not want to end up with a START agreement where we can verify Soviet mobiles and they are deploying them, but we have no program of our own.

I think, on the other hand, what you say is exactly right. Based on past experience in negotiations, we are not going to get the kind of verification regime that is necessary to have effective verification of mobiles unless the Soviets are persuaded that we are serious.

I think the most important signal of seriousness that we can send in these negotiations would be for Congress to approve both of these programs.

SDI

Senator COATS. One final question. Please briefly explain to me how SDI relates to the survivability question and the deterrence factor for the two scenarios and how you factor that program and anticipated progress in that program in meeting these objectives.

Mr. WOLFOWITZ. That is a very complex subject, but I would say in the simplest terms the SDI program is not primarily oriented toward the specific problem of preserving the survivability of the ICBM force.

Senator COATS. Does it have the residual effect?

Mr. WOLFOWITZ. It does have some effect—and obviously this depends on what kind of deployment decision we might make and that decision would not come until the mid-1990s. Depending on what kind of deployment we might make, it would complicate significantly any Soviet attack on any element of our deterrence posture, including critical elements that we are not addressing here at all, such as command and control.

It also does something which no offensive element does, and that is to defend you against limited attacks or against accidental or third country attacks.

Senator COATS. But it is a variable that you factored in in terms of providing deterrence for the land-based section of the triad. Is that right?

Mr. WOLFOWITZ. We factored it in insofar as you can with our present base of knowledge. We would expect, based on the kind of program, the sort of vigorous research and development program that the President has asked for that by 1993–1994 we would have a much clearer idea of what SDI can do for us and we would be able to factor it in a much richer way than we can at this point.

Senator COATS. Thank you, Mr. Chairman. My time has expired.

Senator EXON. Senator Warner.

NATIONAL SECURITY REVIEW OF THE UNITED STATES

Senator WARNER. Thank you, Mr. Chairman. Secretary Wolfowitz, this is a document Congress asked the previous administrations, the national security review of the United States. This is the 1987 version. This is the 1988 version.

As you know, the Goldwater-Nichols Act contains a section which I was pleased to co-author with Secretary Cheney providing for the continuation of this report. Can you advise the committee as to the schedule of this report now?

Mr. WOLFOWITZ. I am afraid I cannot, Senator, but I will get an answer for you as soon as I get back. We are behind on a number of these things but they are very important and we are trying to catch up as fast as we can.

[The information follows:]

Unfortunately, due to the change in administrations in January of 1989, the publication of the National Security Strategy for 1989 was delayed pending a broad national strategy review directed by President Bush. I have been informed by the National Security Council staff that the annual Presidential publication on National Security Strategy for 1989 is currently in the planning stages, and will be published as soon as possible.

Senator WARNER. It really complicates the role of the Congress under our constitutional authority to work with an administration when we do not have a clear road map of where you want to go, how you want to get there and what are the assets you have to do the job.

I would strongly urge this administration be forthcoming as soon as possible on this document. I mean, we are about to go into markup and I do not know what impact this document will now have on the budget under consideration, but I am certainly hopeful that next year we can be more timely and I intend to take some steps to ensure that timeliness.

Mr. WOLFOWITZ. Senator, we will make sure ourselves that we are timely. We appreciate the kind of indulgence that you and others have given us, because it has been a slower than expected transition. But we are trying, as I said, to catch up as fast as we can.

Senator WARNER. Mr. Secretary, General, bear with me a minute while I just state a few of my views here.

As I look at the situation, as I expressed yesterday following a meeting at the White House with the President, the Congress essentially has this President in a gridlock situation. We have got him trapped in a gridlock on this issue of mobility.

We have not been able to reconcile the differences thus far between ourselves on which programs should go forward, or both, or neither.

We had an excellent exchange yesterday with the President. I thought the Speaker in a fair and pragmatic and objective way outlined the problems that he saw in the Congress and urged the President and the leadership to work on a quick resolution.

It is interesting. Following that meeting yesterday there have been discussions between Mr. Aspin, Mr. Dickinson, Mr. Nunn and myself and others, and I am becoming very optimistic that the Armed Services Committees are going to provide a strong element of leadership to work our way out of this gridlock.

If I had to make bets today I think that programs are going to be authorized and hopefully the Appropriations Committees will follow on with the requisite funding.

Now, assuming that we do break the gridlock, the President is then given a matter of discretion as to how to deal with the issue of mobility in the present START talks. It is my further hope that we do switch our position and state that out of these talks should come a framework for both the Soviet Union and the United States to provide as a part of their respective strategic deterrence an element of mobility.

Now, whether it is both systems, one system or some kind of a mix, that remains to be seen. But I assume that the START agreement will establish this framework and then we will have to come back and revisit the Congress next year about the justification for having a mobile system and to get the requisite funding.

I believe just because the Soviets now have two systems, that is not sufficient justification for us to have a system. We have got to come up with a better one and I would respectfully suggest the following.

There seems to me far more reason for the United States to have a mobile system than the Soviet Union and that is primarily because of geography. We are a nation that is dependent on the sea lanes of the world. We are basically an island nation for the purposes of our redeployment, for purposes of our forward-deployed forces, and as we see the beginning scenario—it appears to this Senator—less dependence on the concept of forward-deployed forces.

The President has suggested some 30,000 be brought back from NATO if certain conditions are made in the conventional talks. We see an instability in the Pacific Rim, whether it is the Philippines or South Korea or elsewhere.

FORWARD DEPLOYMENT

In other words, do you agree that the concept of forward deployment, which has served this Nation very well since World War II, is not being put to a severe test both in Europe and in the Pacific Rim area?

Mr. WOLFOWITZ. I think it is being put to a test. I hope it withstands the test, Senator, because I think the experience of this century demonstrates that the best way to defend our own country is with forces deployed overseas. Through this strategy, we have been able to preserve the peace for 40 years. When we followed a different strategy, we ended up in the two worst wars of our history.

Senator WARNER. I concur in that.

Mr. WOLFOWITZ. I think that principle is a fundamentally correct one. That does not mean you cannot change it in significant ways—the President proposed that the Soviets make major reductions in their forces in Europe, and we could, in turn, reduce ours in Europe. But I would hate to see us abandon the basic principle.

Senator WARNER. I am not suggesting that we abandon it. I just say that it appears to me that the signs on the horizon are going to put greater pressure on the concept of forward deployment, and that therefore, we should put greater reliance here at home on systems which are less vulnerable, and the mobility certainly offers that. And it is for that reason that I strongly support both systems and have for some period of time.

I think it is essential for us to go forward with both systems, because I do not have the sense of security in the out years that perhaps you and others have that this concept or forward deployment is going to remain. We have got 1992 coming on in Europe, which is a dramatic change in all of the relationships between those nations; and we do not know what the evolution will be out of that.

So I would hope that you would give a little thought to that reasoning, and in the years to come perhaps we can add another reason for mobility, not just because the Soviets have it and we have got to have it, but because there is a difference between geographical and strategic relationships of the two nations.

I thank the witnesses. I see my time is up. I will wait for another round.

Senator **Exon**. Thank you, Senator Warner.

Senator Lott.

Senator **Lott**. Thank you, Mr. Chairman.

ADVANTAGES OF SILO-BASED ICBMS

General Welch, one of the advantages of our silo-based ICBMs has been their accuracy. How much of a degradation of this accuracy do you have with these mobile systems? Do we know, and how much is it?

General **Welch**. We expect very little degradation.

Senator **Lott**. Very little degradation.

Also, I have heard that some people have been advocating a hardened mobile system called CARRYHARD or something like that. What is your assessment of that concept?

General **Welch**. Well, the hardened mobile system for the Peacekeeper would be CARRYHARD. I have lots of difficulties with CARRYHARD, but I guess the greatest difficulty I have is it is very, very expensive. It would cost more to put the Peacekeeper in CARRYHARD than to buy an equivalent number of Small ICBM warheads on Small ICBM. And, of course, the great value of the MIRV missile is the lower cost, so we give up that value by going to CARRYHARD.

There are also lots of operational and technical questions that have not been answered by CARRYHARD. So, I much prefer the combination of rail mobile Peacekeeper and road mobile Small ICBM, and you get that for a lower price.

Senator **Lott**. Mr. Secretary, I guess over 10 years ago when I was in the House, the President was Carter, we were debating the same issue. I think it is high time we make a decision and go forward. And I have a preference for the Peacekeeper, but I am about to the point where I will take either. But I really have to question whether the right solution is both. After all these years of going back and forth, all of a sudden now we are saying all right, well, we will just have both.

PEACEKEEPER FUNDING

But the main objective I have in mind this year is to make a decision and start moving it forward. What is that schedule in terms of, you know, what kind of funding would we need for the Peacekeeper in the next fiscal years? I have seen this in the paper, but do you have those numbers on what are we talking about with the Small ICBM with funding for next year, and how does that escalate up in 1992, 1993, and 1994?

Can you give me some of those numbers and a schedule?

Mr. **Wolfowitz**. General Welch, I think, can speak to that. Let me just endorse the idea that it is time we got on with a decision. And I recognize you can say maybe it should be one missile, maybe it should be the other.

The President has made a decision that has, in fact, attempted to take into account not only his own views, I think, but the urgent need, for a national consensus and for a demonstration to the Soviets that we have a program, and we are all behind it. I think this decision is long overdue. I could not endorse that comment more strongly, Senator.

Larry, do you want to speak to the details of funding?

General Welch. Well, I can talk about the costs in detail, but I would also point out that the Air Force and the administration's solution since the Scowcroft Commission has always been both.

Senator Lott. Has always been both?

General Welch. Has always been both. It is just in 1988 we could not find any way to face up to the $40 billion price tag on the schedule that we were contemplating.

Senator Lott. And now we can?

General Welch. So now—well, we have sequenced it. The cost of the Small ICBM has come down considerably. And by the sequencing and the lower cost of the Small ICBM, we can now see our way to afford that. So I would say that we are back to both.

And as for the costs, we are asking for Small ICBM in the next—we are asking for $100 million reprogramming from the ICBM line in 1989, and $100 million in 1990, and $200 million in 1991. The total for FYDP for the Small ICBM is $1.2 billion plus $.947 billion, so it is $2.147 billion for the Small.

Senator Lott. Over?

General Welch. The FYDP.

Senator Lott. Over how long?

General Welch. Over the 5-year period. It is $100 million in 1990, $200 million in 1991, and $2.147 billion over the 5-year period.

For the Peacekeeper, of course, there are two lines. One line is completing or continuing to buy the OT&E missiles that go with the Peacekeeper, whether or not it is in the silos or on the rail. That line in 1990 is $787 million, in 1991 it is $654 million. The separate line for putting it on the rails in 1990 is $1.1 billion, and in 1991 it is $2.1 billion.

Senator Lott. That is $1.1 billion and $2.1 billion.

General Welch. Yes, sir.

Senator Lott. Thank you very much. That helps clarify the numbers at least.

Mr. Secretary, you say in your conclusion, "The President's program represents sound deterrent policy, it represents sound fiscal policy, and it represents sound arms control policy." I think I might could accept the deterrent policy and the arms control policy, but how does it represent sound fiscal policy?

Mr. Wolfowitz. Because I think by the sequencing, we are doing something that fits within an affordable spending profile. We are not trying to do everything at once. We are not trying to rush a program into the field with the excess costs that that would entail.

Senator Lott. There is no question that the arms control consideration is a major one in how this decision was made, right?

Mr. Wolfowitz. We, in fact, took the strategic look first without regard to arms control and took the view that if we do not have an arms control agreement, we want to have mobility in our ICBM force. If we have an arms control agreement, we still want to have that mobility, but then we have introduced another very important consideration, and that is verification. We have to have effective verification if we are going to talk about limited forces.

So I would say that arms control played a major role, but very consciously we first tried to figure out where we want to be strategically, and then we factored in arms control as part of that.

Senator LOTT. Thank you, Mr. Chairman.

Senator EXON. Thank you, Senator Lott.

We have now finished our first round. We will start on the second round of questioning. And since he has a prior commitment, I am pleased to yield my first round to Senator Gore.

Senator Gore.

Senator GORE. Thank you for your courtesy, Mr. Chairman.

I was just going to start by complimenting your statement earlier.

Senator WARNER. The measure of courtesy being displayed by the Chair today is so unusual, I wondered what the problem was.

Senator GORE. Is this coming out of my time?

Senator EXON. No. It is coming out of Senator Warner's time. [Laughter.]

SOVIET AGREEMENT ON BAN OF ALL MOBILE MISSILES

Senator GORE. Let me start, then, by complimenting Senator Warner on his earlier statement, and let me begin this round of questioning with an assumption on my part that I will not ask you to necessarily agree with, but I think it is a reasonable assumption. And that is, that we are unlikely to secure Soviet agreement to our present proposal for a complete ban on all mobile missiles.

Now, I think the position I have just stated, the opinion I have just stated has been widely shared and was in the Reagan administration, and I think it is widely shared now. But just to state it as an assumption, General Welch, what would be the implications for a strategic posture if we had an agreement, and we had a relationship with the Soviet Union where they had two mobile systems, and we had none, at least during the period while we were continuing the research on SDI? What would be the implications for them to have two mobile systems and for us to have none?

General WELCH. Well, without overstating the danger, I think it is very simple. That says a major part of their land-based ICBM force is totally immune to counterforce, or largely immune to counterforce, not totally, while our land-based ICBM force is not at all immune to counterforce. And that is the kind of imbalance that brings about instability.

I think we have to constantly remind ourselves when we talk about this two-sided equation that however broadminded you might want to be, we have to deter the Soviets. The Soviets do not have to deter us.

Senator GORE. Now, one of the positions that has been advocated by many, both within the administration and in the Congress, including the chairman of this committee, Senator Nunn, and the chairman of our sister committee in the House, Congressman Aspin, has been the possibility of a proposal to ban land-based mobile MIRVed missiles. If we adopted that position, and we did not have the Small ICBM program in development, what would be the implications?

General **Welch**. That is a complex subject. I will try to answer succinctly. If we banned mobile land-based MIRVs, then we are faced with two options. We can drive the MIRVs back into the silo, which is clearly destabilizing, or we have to substitute a single, a non-MIRVed substitute, which would be very, very expensive for a fairly small gain over the kind of stability that you can get from a dispersed MIRV. But clearly, you have only two choices.

Senator **Gore**. If you did not have a Small ICBM in development.

General **Welch**. Or if you do have a Small ICBM in development, then you have to buy the additional warheads to make up for what you expected to get out of the survivability of the mobile MIRV.

Senator **Gore**. Right. So a position that bans land-based mobile MIRV systems requires—would be rational only if we had a single warhead mobile missile in development as a complement to the Soviet SS-25?

General **Welch**. And were willing to spend the money to compensate for the warhead effectiveness or the warheads that you lose by banning the mobile MIRV.

Senator **Gore**. Right. All right.

BARGAIN ON MOBILITY

Now—and well, of course, presumably the target set on the other side would be altered both by the mobility of their single warhead force and because of a reduced target set with the elimination of the SS-24. So if the President wants to bargain on mobility, his hand is strengthened by the package that you are supporting here today.

In other words, our country is going into the negotiations with the Soviet Union. They have the SS-24, they have the SS-25. One of the leading arms control options under consideration is a ban on land-based MIRV mobiles. There are other options under consideration.

The way to preserve our flexibility in those negotiations is, first, to have a domestic consensus that backs up our negotiators, and, second, to give the flexibility to the President of the United States that comes from having these two programs under development, so that a range of outcomes becomes possible from the negotiations.

SMALL ICBM

One final question. If we got a START agreement that had much deeper reductions, then even more flexibility would be needed in our forces, and the value of the Small ICBM would be enhanced. Would you agree with that, General?

General **Welch**. I think I would agree that the deeper the reductions are, the more demand for high quality, flexible forces after the reductions. Any of our modern warheads provide high quality, flexible warheads.

Now, the question of whether or not you can use a MIRVed warhead or a MIRVed missile depends on what kind of target set is left after the deep reductions. And that is a very complex matter of seeing whether or not you have a target complex remaining that calls for MIRV missiles. I can hardly imagine that you would not for some number.

Senator GORE. Right.

General WELCH. Perhaps not a large number, but for some number.

MIRV MISSILE

Senator GORE. But generally speaking, while MIRVs offer some advantages, so also do single warhead missiles. And there are many situations in which the Air Force feels the need for a single warhead missile because of the flexibility it provides, correct?

General WELCH. Clearly, MIRVs offer a cost advantage. That is the single advantage of a MIRV missile; it saves money.

Senator GORE. Right.

General WELCH. So if money was no object, we would much prefer not to have MIRV missiles.

Senator GORE. Because they are more attractive targets, and they have implications—and they are destabilizing except with extreme and thus far inaccessible measures taken in their deployment. But just to conclude this, if we have deep reductions which limit the number of warheads available to each country, then there is a premium on the quality of the warheads remaining, and the flexibility with which they can be used, and the survivability of the manner in which they are based. Would you agree with that?

General WELCH. I think you have reached my hypothetical threshold. There are so many hypotheticals in there, I hardly know how to respond.

Senator GORE. Let me simplify it. The deeper the reductions on the number of warheads, then the higher value one places on the survivability and flexibility of the warheads which remain.

General WELCH. As a principle?

Senator GORE. Yes.

General WELCH. As a principle, I would agree with that.

Senator GORE. All right. Thank you very much, Mr. Chairman.

Senator EXON. Thank you, Senator Gore.

Senator Wallop.

Senator WALLOP. Thank you, Mr. Chairman.

MIDGETMAN VERSUS SDI

Mr. Secretary, I am trying to pin down two answers that you gave separately to Senator Gorton and Senator Coats. You both, I think, implied in response to Senator Gorton's question as to the relative value of SDI versus Midgetman that there were thorough reviews that took place that brought us to the position that it was cheaper and more efficient to go the way of the small mobile than it was to defend.

Is that a correct statement?

Mr. WOLFOWITZ. Yes, Senator.

Senator WALLOP. Do those thorough reviews exist? I mean, General Welch's responses kept saying, I think—all I am trying to find out is if they exist and they might be available to somebody to review.

Mr. Wolfowitz. I guess the question in a way is the extent of thoroughness, but I would note the reviews that we did were based on what we know now about what SDI can do. We may know much more in 4 years, and the conclusion would be different.

Senator Wallop. That is exactly what I was getting to, because in response to Senator Coats, you said in 1993 or 1994 we might be able to tell a little more about the relative value and efficiency. So I am wanting to know how we got to this thing and how we are going to know something in 1993 and 1994 that we already claim to know today.

General Welch. Let me make it very straightforward. We know that we can take those 50 MX missiles out of the silos and put them on the rails for $5.6 billion. I know you cannot deploy any kind of effective defense for that price.

Now, when you talk about a broader task, of going mobile on a broader scale, then perhaps the balance will change. But I know for a fact——

Senator Wallop. I guess that is my question, that is what I sought out of this. So that, in fact, we do not yet have a positive decision that a Midgetman would be cheaper or more efficient than a defense in approximately the same time period?

General Welch. I would doubt seriously that you can deploy an effective defense for the price of a Small ICBM, but I am not certain about that.

Senator Wallop. You know, one of my problems is that those who are most skeptical about the reduction in the forecast price of SDI are the most credible on the reduction of the forecast price of the Small mobile ICBM. What makes one more credible than the other?

General Welch. The Small ICBM is a full-scale development program. We clearly have that laid out. We understand the costs. For anyone to tell you that we have a zero chance of having some surprise in Small ICBM which would raise the cost of course would be nonsense. But so far as we know, we have a fairly solid handle on it, whereas we are in a totally different position on SDI. On SDI we are in the midst of advancing the technology that will allow us to understand the best approach to SDI and what it might cost. So we are in two different positions.

Senator Wallop. I think we are in the midst of an argument as to whether we dare confront the question of the ABM Treaty more than we are the question of confronting the technological capability.

General Welch. Oh, no. I am very much on the cost issue. We really do not yet have the knowledge that we need to tell you what it would cost to provide the kind of defense that you are talking about. We are on the right path to get that knowledge and to provide that decision, but we really do not know that yet.

Senator Wallop. Well, let me ask if we know another thing then, because if both sides end up with mobile ICBMs, and if deterrence were to fail, would our mobile ICBM be of any value in destroying their mobile ICBMs before they were used against us?

General Welch. No, no. The only thing——

Senator Wallop. So there is a question that has to come back into the play of defenses, does it not?

General **Welch**. Of course, the issue is the overall triad.

Senator **Wallop**. I understand that, but the question was if it were to fail, and it is a hypothetical, too. But the purpose of all of this is to be credible if it does fail.

General **Welch**. Well, the purpose of all this in my mind, Senator, is to be sure it does not fail.

Senator **Wallop**. True. But the only way that that is of any value is if you are certain under all sorts of circumstances.

General **Welch**. The Soviets will have to be confident that we will inflict unacceptable losses on them as a result of their attack, that is correct.

Senator **Wallop**. Thank you, Mr. Chairman.

Senator **Exon**. Thank you, Senator Wallop.

Senator Nunn.

B-2

Senator **Nunn**. General Welch, as you already know, there is a considerable amount of opposition mounting to the B-2 program on Capitol Hill. Part of that is because of the problems with the B-1. Part of it is because of the overall budget squeeze. There are, I am sure, other reasons, but the most legitimate—and I am one who has supported the B-2 and hope to be able to continue to—but the most legitimate critique right now of the B-2 program is that it has too much concurrency.

I would first like for you to address that issue, whether you believe that is accurate criticism. By that I mean that we are not flying before we buy.

And second, I would like to have you give us your opinion as to whether there is a way the program can be adjusted to give us more assurance that when we build this bomber, if we build the bomber, that we are not going to make some serious mistakes by moving too rapidly. It gets down to the question where the production money itself being requested is going to be in serious question over here.

So I would like for you to address the question of whether we have too much concurrency, and whether there are ways to get more assurance that the B-2 program indeed has flown and will be technically sound before we go into more production.

General **Welch**. Yes, sir. Of course, we have controlled concurrency by adjusting the schedule. Had we not adjusted the schedule, I would agree we would have had too much concurrency. We have slowed down the funding of that program significantly by something longer than a year, in fact, with the President's submission this year, because we were concerned about concurrency.

Senator **Nunn**. But you still are asking for production money in this year's budget, and you still have not flown the aircraft.

General **Welch**. That is correct. But in just addressing the concurrency issue, I think we have made the proper adjustment to manage concurrency.

Now, the question of fly before you buy. That is always a balance between confidence and the cost of the program, that building a bomber aircraft, a large aircraft of this nature, takes about 3 million manhours to put the first airplane together, and that airplane is put together on the same tooling that we will put the second, and the third, and the fourth airplane together. The second airplane takes something like one-fourth that number of manhours.

My point being, this is just one example of what you face if we would indeed try to build a couple of airplanes. And for a Stealth airplane, for it to be useful in any kind of test program, you have to have high assurance that the production airplane will be externally identical to the airplane you are testing, because the Stealth characteristics are such an important part of this program.

But if you were to attempt to build three or four airplanes and go out and test those airplanes, and in the meantime shut down the production line, you would reduce the risk, and reduce the concurrency, and raise the cost of the program enormously, and that is the tradeoff. So what we have done is put on the front end of this program an extensive risk reduction effort, which took, by the way, a year longer than we expected it to.

We have 24,000 hours of wind tunnel time on the airplane. We have endless hours of simulation on the airplane—all to reduce the risk without incurring the tremendous cost of shutting down the whole line and then restarting it later. That means restarting the vendors, it means all those security clearances again, it means rehiring the people, and most of all it means a learning curve. It means going back to 3 million manhours to build the next airplane.

Senator NUNN. You are saying if we take the production out for 1990, what will be the result, in your words?

General WELCH. I am not sure. If we take production out for 1990, I am sure the cost will increase, the total cost of the program will increase substantially.

Senator NUNN. Could you submit for the record what that estimated increase in cost will be if we take the money out for 1990? The same question for 1991.

General WELCH. We are working that, and I will provide that for the record.

[The information follows:]

B-2 ESTIMATED INCREASE IN COST

The estimated cost increases for zero procurement in fiscal year 1990 and fiscal years 1990-91 are $4.2 billion and $9.2 billion, respectively. The estimated program cost which supports the restructure program approved by the Secretary of Defense during the May 31, 1989 Defense Acquisition Board is $70.2 billion dollars. The estimated program cost of a program with no aircraft purchases in fiscal year 1990 is $74.4 billion dollars. The estimated program cost of a program with no aircraft purchases in fiscal year 1990 and fiscal year 1991 is $79.4 billion dollars. It would be impossible to zero fund procurement in a particular year because the overhead and allocated sustaining, advance buy, spares, support equipment, fixed priced options, and site activation charges have to be allocated to that year even though no aircraft are purchased during the year.

General WELCH. By the way, delaying the program for 1 year costs $3 billion.

Senator NUNN. How much?

General WELCH. The 1 year we have already delayed the program adds $3 billion.

Senator NUNN. Three million or $3 billion?

General WELCH. Three billion.

Senator NUNN. Billion.

General WELCH. To the program cost. So that gives some rough idea of what is entailed in doing that sort of thing.

Senator NUNN. Could you tell us in your words what the comparison is between the B-2 concurrency—that is, going into some production before we fly the aircraft—with the B-1 concurrency?

General WELCH. I can give you some more enlightening numbers for the record to give you some mathematical measurement.

[The information follows:]

COMPARISON BETWEEN THE B-2 CONCURRENCY

The B-1 was a highly concurrent program structured to produce the most capability at the lowest cost in a program where the risk was considered low to moderate in most areas. We had completed only some 50 percent of the flight test program when production quantities were funded at 100 percent. In contrast, the technological challenges of the B-2 have been well understood from the outset. We have adjusted the schedule with the slip in 1st flight. As a result, we will have far more flight test activity behind us before committing to large numbers of production aircraft and well before deliveries which tend to lag production funding by more than 2 years. We'll reach 50 percent of flight test completed with less than 20 percent of production aircraft on contract. Further, the earliest testing will confirm the airframe and engine design parameters. In the first 2 years we will have explored the entire flight envelope; 90 percent of propulsion testing will be complete and 70 percent of radar signature testing will be complete along with testing of other systems, flight loads, etc.

Senator NUNN. I would like that for the record, but just your off-the-top-of-the-head comments?

General WELCH. I think there is no comparison that the B-1—and by the way, I have to say that I do not agree that the B-1 has been a disaster. It is a good airplane. It is out there doing its job right now, but we have some problems yet to fix. But having gotten——

Senator NUNN. Did I say that? I did not——

General WELCH. Having gotten that little commercial in——

Senator NUNN. I do not think I said that.

General WELCH. I needed the commercial anyway.

Senator NUNN. I said we had problems with it. I do not think I said disaster.

General WELCH. But it is an entirely different approach to the program. It is absolutely true that the B-1 was strongly and urgently driven by a schedule. There was a cost schedule and performance drive on the airplane, and cost and schedule are immutable drivers, that we had to have that airplane at IOC by September 1, 1986. We had to do the whole program for $20.5 billion. And those were immutable numbers. Consequently, the program was very strongly driven by the calendar.

We have not taken that approach on the B-2. We understood at the outset that there were tremendous technical challenges to be overcome on the B-2. Schedule is important, because schedule is money; but on the other hand, performance milestones were the driver on the B-2 program, and they remain the driver.

Where we thought concurrency was becoming a problem, we have changed the schedule. Where we felt like we were rushing towards a milestone, not properly prepared for that milestone, we have changed that milestone date. So it is a totally different philosophy involved in the B-2 program.

Senator NUNN. It would be helpful if you submit for the record the changes already made. I do not think there is a common realization here as to how much that program has already been slowed down.

Are you saying, then, that we have less concurrency in the B–2 program than we had in the B–1 program at similar stages?

General WELCH. Oh, far less.

Senator NUNN. Are you saying we have less risk in the B–2 program, even considering the complexity, than we had in the B–1 program?

General WELCH. Well, I would say that is true for a couple of reasons.

Senator NUNN. Say it in your words. Say what is true.

General WELCH. It is true that we have less risk at this point this near first flight for B–2 than we had this near first flight for the B–1.

Now, it is a different kind of risk. In the B–1, very little risk about the basic airplane. In the B–2, very little risk regarding the basic airplane. In the B–1, considerable risk regarding the ECM system, obviously. The ECM system is a very—an extensive ECM system is very important to the B–1, and we were in a very high risk position vis-a-vis the ECM system. We have no comparable high risk systems on the B–2.

So while it is true that the overall airframe-engine risk for the B–2 is slightly higher than it was for the B–1 at this point in time, although not high, that we do not have the risks that we were facing in the defense avionics and other systems on the B–1.

Senator NUNN. There is no comparable risk in some other area on the B–2?

General WELCH. I do not know of any, no, sir.

Senator NUNN. So you are saying, without any doubt in your mind, that the risks are lower at this relative stage on the B–2 program than they were on the B–1 program.

General WELCH. In terms of the overall weapons system, yes, sir.

Senator NUNN. Thank you, Mr. Chairman.

General WELCH. Thank you, Senator Nunn.

Senator Warner.

Senator WARNER. Could I defer to Senator Wallop?

Senator WALLOP. I have no further questions.

B–2

Senator WARNER. Let me just follow up Senator Nunn's question on the B–2. I have been a strong supporter of that aircraft, and I was working with Senator Nunn and others to see what we can do, and your answers on these questions are going to be helpful.

I do not want to see this aircraft become the Spruce Goose of the 1990s. You remember Howard Hughes' famous airplane of World War II. It got put in the barn after its first flight.

Could you clearly state what the mission is of the B–2, and why that mission is essential, given the high cost of this program?

General WELCH. Let me start with the mission of the penetrating bomber. The penetrating bomber is by far the most efficient way to cover a very large set of targets that are essential to deterrence.

They cannot be covered as efficiently any other way, and some of the targets cannot be covered any other way.

Senator **Warner**. Now, that is important. Some targets simply cannot be covered in any other way except the manned bomber.

General **Welch**. Practically speaking, they cannot. With what we know today and what we have available today, there are certain targets that really cannot be covered any other way.

Senator **Warner**. Without, of course, getting into classification, to what extent can you identify so that the public—now, mind you, we have got to go back and articulate this program before an American public which has a growing suspect about the bomber.

General **Welch**. Well, I think it is easier, rather than identify a specific set of targets and——

Senator **Warner**. Well, the character of these targets, just a generalization.

General **Welch**. Well, let me talk about the characteristics of the penetrating manned bomber that you cannot get any other way. Number one, it has the highest yield and highest accuracy. It carries the highest yield weapons and delivers them with the highest accuracy. There are certain targets that require that.

Second, it is the only system that can check suspect areas and attack things within suspect areas where the location is generally known but not precisely known. Now, that is totally different than chasing relocatables around the countryside. I am saying as much as I can say in an open forum, we have the means to narrow the location of some important things to a manageable suspect area. Only the manned bomber can then hold things within that suspect area at risk.

Even more importantly, for a very large class of targets you can cover with a single bomber weapon, or in some cases you can cover several targets with a single bomber weapon. To cover those any other way would take several warheads and cost far more. And, of course, that is the efficiency issue.

As to what makes the B-2 unique over the B-1, because the B-1 is obviously a penetrating bomber, there are two or three facets of the B-2 that are absolutely unique. One is that for decades to come, the B-2 will be able to penetrate the most heavily defended parts of the Soviet Union. That is not true of the B-1. The B-1 does well today, can cover most targets today, and with planned upgrades can cover a lot of targets for years to come. But those key targets in heavily defended areas, which tend to be very important targets—that is why they are heavily defended—only the B-2 will over time be able to continue to penetrate to those targets. Furthermore, the B-2 has the ability to operate at all altitudes, and that greatly increases the utility of the sensors and the things that you use to handle that class of targets that I talked about earlier.

Third, if the Soviets attempt to mount the kind of density of defenses that are required to substantially threaten B-2s, the cost will be enormous. The cost will be a multiple of the cost of the B-2.

Senator **Warner**. I want to interrupt you, General, because I want to get one more question in under my time. But I suggest that Secretary Cheney and yourself and others examine this question in light of the need for Members of Congress to articulate the justification for this extraordinarily costly instrument——

General **Welch**. We are working on it.

Senator **Warner** [continuing]. Back home and elsewhere to give us the support we need to make what I believe is the right decision for our national defense. I recognize the problems that we have. When you talk about the suspect areas, down in Crossroads, VA that is not going to sell, to put it bluntly.

General **Welch**. We are struggling to find a simple way to talk about this.

Senator **Warner**. And I am perfectly willing to have the courage to take the heat, but to the extent that you can help us, give us some help.

ARMS CONTROL AND VERIFICATION

Now, let us go to the question of what is on the table in the arms control arena, and I am somewhat concerned about this verification subject and how it relates to the mobile forces. Let us look at if we are going to have a successful START agreement, it is going to preserve the right of both nations to have a mobile force, in my judgment.

I want to know what the impact of the verification procedures will be on that phrase that General Welch just used, in other words, mobile forces are immune from counterforce. If we go ahead with the current position, which I understand has suggested geographical areas, i.e. did not we at one time, Mr. Wolfowitz, put 25 square miles on the table, and the Soviets put 100?

Could you address yourself to that area of verification under the Bush program that is now being articulated in Geneva?

Mr. **Wolfowitz**. Obviously, there is a certain tension. On the one hand, we want to be able to verify the missiles. On the other hand, we do not want the other side to be able to target them.

Senator **Warner**. That is precisely what the question is.

Mr. **Wolfowitz**. And some of the most critical things that would be, in our view, most useful for verification are things like verification of the production of the missiles themselves. That is what gives you probably the tightest handle on the total numbers, and that has nothing to do with targeting information.

The question that you asked about the possibility of restricted areas, restricted deployment areas and notification of operational deployments outside of those areas is where we have spent a lot of time trying to work out proposals that would try to balance both of those considerations. But I think the general answer is a feeling that it can be done and can be done in a way that gives you the information after the fact to tell whether the other side has been abiding by the rules, but does not give an attacker the information before the fact.

And, of course, it comes back, I think, to the fundamental point, too, that if we are talking about the kinds of intense crises that we have said repeatedly are the ones that are of most concern to us, I think those kinds of notifications would simply probably cease. We are talking about how to maintain confidence during peacetime that each side is abiding by the limits.

Senator **Warner**. To the General, Mr. Chairman, I address his concept that he articulated quite well, that mobile forces—I think your phrase should be "less subject to counterforce." I think you had the absolute.

General **Welch**. I changed that.

Senator **Warner**. Those who check the record will quietly rewrite your phrase.

How does that formula relate to what is on the bargaining table today? And what is your advice to the administration on this?

How do we deal with this question of verification and at the same time preserve the relative invulnerability of the mobile forces?

General **Welch**. Well, just for example—and by the way, I hasten to correct that earlier, that they are relatively much more difficult to attack. I think the answer to that question lies in our own deployment plans.

We have intentionally laid out a deployment scheme for our mobile missiles that we think contributes greatly to adequate verification, and at the same time in no way makes them targetable in crisis. It is much the way we count bombers. The most mobile thing there is a bomber. A bomber moves from base to base. We have them in hangars. We have them in depots. And yet we have very high confidence that we know to very close tolerances how many bombers the Soviets have, because we do know the production capacity. As Mr. Wolfowitz suggested, it is important in mobile missiles.

And also, while the bombers are free to move, they generally are found in nests of known locations. And over time, when the bombers are generally in known locations, you build up confidence that we know how many bombers they have.

We have a very similar deployment scheme for both our mobile missiles. The rail missiles would normally be in garrison. They are not restricted to garrison. We can take them out any time we want to, but normally that is where they are. Our Small ICBMs will normally be in restricted areas. Again, we are not restricted to that, but we agree that is where they will normally be.

So over time then you can build up confidence that you know how many there are, so it is not an impossible task. But we simply have to get the Soviets to agree to some of the measures that would give us the confidence we need.

Senator **Warner**. Mr. Chairman, I think we are fortunate to have these two extremely competent professionals address perhaps the toughest issue that exists today in our whole security question. I am grateful we have these two competent individuals serving the country.

Senator **Exon**. Thank you, Senator Warner.

Senator **Levin**. Thank you, Mr. Chairman.

VERIFICATION

Mr. Wolfowitz, let me go back again to the verification issue. Can we effectively verify a total ban on mobiles today? Is that the basis of our former arms control position, that we wanted a total ban because we believed we could effectively verify such a total ban but could not effectively verify a limit?

Mr. Wolfowitz. Well, we are effectively verifying a total ban on SS-20s today, Senator, as you know. And, generally speaking, a total ban is much easier to verify.

Senator Levin. Is it fair to say, then, that the basis of our position up until now at the START talks in favor of a total ban on mobiles was that we believe we can effectively verify such a total ban?

Mr. Wolfowitz. My understanding is that was the philosophy behind the total ban position, yes.

Senator Levin. Now, we do not know yet, I gather, whether we can effectively verify a limit on mobiles, and that is what we are going to be working on over the next few years; is that correct?

Mr. Wolfowitz. Hopefully not the next few years, but that is what we are going to be working on in the negotiations and in the kinds of——

Senator Levin. But how long do you figure it will take? What is your goal for determining whether we can effectively verify a limit on mobiles?

Mr. Wolfowitz. I would not want to put a time limit on it, Senator. A lot depends on how much the Soviets are willing to agree to, and a lot depends also on the kinds of things that we can learn from the sort of joint experiments, joint tests of verification procedures that we are proposing we undertake with the Soviets.

Senator Levin. But when I said a couple of years, you bridled a bit at that and hoped it would be less than that?

Mr. Wolfowitz. It is certainly my hope it would be less than that. I have not seen anyone put a time limit on that, but that seemed to me a surprisingly long time.

Senator Levin. Now, if we decide that we cannot effectively ban a limit on mobiles, will we then be sticking to our original position that there should be an absolute ban on mobiles?

Mr. Wolfowitz. Let me repeat, our goal is to get to where we can effectively verify, and we can deploy in a mobile mode.

Senator Levin. If we are frustrated in that goal?

Mr. Wolfowitz. Then you have got to figure out the next step—it is a very hard thing to predict. It depends on what the degree of risk we think is going to be attached to what verification regime we can get.

Senator Levin. Are you suggesting that even if we decide we cannot effectively verify a partial ban, that we still might go for it?

Mr. Wolfowitz. No. What I am saying is I doubt if the answer is going to come in absolute form. There are great benefits to be had from having survivable mobile missiles, and there are some risks and costs associated with varying degrees of inadequacy of verification; and we are going to have to see in the end where we come out on that balance.

But let me say that it is a sort of chicken and egg problem, and it is very bad to separate the two issues, because how well we do with the Soviets in these negotiations, how well we can do on verification is going to depend on how strongly we support the programs and look like we have a program of our own. So I think we will get to the best answer if, in fact, the Congress will support the President's request for these two missiles.

MX AND MIDGETMAN

Senator **Levin**. General, if both the MX Rail Garrison and the Midgetman were deployable now, if we were at the production stage of the Midgetman now and it was deployable now, would you be recommending that we do both systems?

General **Welch**. Sure.

Senator **Levin**. So it is not the fact that one is coming now to fill some kind of a window and one is not available until later that is the basis of your recommendation. If they were both available now for deployment, you would recommend go with both now.

General **Welch**. Well, again, we would have the cost issue. We might still have to sequence them because of cost, but clearly, the choice to go with the MX first is because it is here first.

Senator **Levin**. Well, if Midgetman were here now, would you not go with Midgetman first?

General **Welch**. Yes, yes. If Midgetman were here now, ready to deploy, and cost was not a consideration, I would go with Midgetman first, because that adds warheads.

Senator **Levin**. And Midgetman gives us survivability against both a surprise attack and an attack during a crisis, is that not correct?

General **Welch**. That is correct.

Senator **Levin**. You would have that survivable, mobile, land-based system against both those contingencies with a deployed Midgetman.

General **Welch**. That is correct.

Senator **Levin**. Would you then, having deployed Midgetman, proceed to take MX out of the silos and make those mobile as well, or having had a deployed Midgetman with mobility, would that not suffice to give you that survivability?

General **Welch**. I would prefer to see MX on the rails regardless, with or without Midgetman.

Senator **Levin**. Even if you had a deployed Midgetman.

General **Welch**. Yes, I would.

Senator **Levin**. And even if you had both contingencies covered with that Midgetman.

General **Welch**. Well, let me clarify a couple of things. One is that survivability improves stability, and there is not some cutoff line where that is not true any more. And you have a great deal more flexibility if we have these things in a survivable mode, assuming we can afford it. So regardless of whether or not we had 500 Small ICBM warheads deployed in a mobile mode, I still think it would be wise to move the Peacekeeper to the rails.

The second part of it is that I would not characterize the value of Small ICBM as being defense against "bolt out of the blue" attack. I do not deny the value of that, but the real value of the Small ICBM is the fact that it gives me all the flexibility. You can save it for the reserve force and therefore control escalation. It has the accuracy so that you can use it initially, if that is what serves best. But it is the quality of those warheads and the flexibility of those warheads that gives the value to Small ICBM, not just the fact that it can survive.

AIR FORCE POSITION ON MIDGETMAN

Senator **Levin**. The Air Force has changed its position on the Midgetman in the last year, I gather. It was not recommending Midgetman a year ago. Is it not fair to say that it is trying to get out of this gridlock, which Senator Warner has referred to, that the Air Force is recommending that we should go with both systems?

General **Welch**. Well, that certainly is a factor, but that is not the principal factor. We dropped Small ICBM because it was $40 billion in the budget, in a timeframe when we would have had to give up conventional forces in order to fund that $40 billion. And the Air Force was unwilling to do that.

Senator **Levin**. Are you not giving up the F-15?

General **Welch**. F-15Es? We are giving up F-15Es a couple years earlier than we would like to give them up, but that is because of a lot of things, not just Small ICBM.

Senator **Levin**. It is an affordability issue, though, is it not?

General **Welch**. Yes. The affordability issue has not gone away. The Small ICBM, the way it is currently phased, is not nearly such a big chunk of that affordability issue in any year that it was in 1988. We are talking about $6 billion.

Senator **Levin**. My time is up. Thank you.

Senator **Exon**. Thank you, Senator Levin.

Let me ask you this question, General Welch. You have heard it before, but I want to get it in the record once again.

PREPARATION PRIOR TO SOVIET ATTACK

How confident are you that we would see days to weeks of preparations prior to any rational Soviet attack on the basis of their present alert posture?

General **Welch**. Let me answer that question by saying that the word "preparation," "strategic warning," et cetera, generates visions in people's minds that are different. I am confident we will have days, weeks of warning that there is a developing crisis to which we ought to be responding by increasing our alert posture.

Now, whether or not that comes to—strategic warning usually connotes that you see signs that an attack is about to take place. My point is that we do not need that kind of warning. All we need is the knowledge that there is a developing crisis that increases the danger. And I think we can be confident that we will have days of warning that there is a developing crisis.

Senator **Exon**. My question was asked with regard to a "bolt out of the blue" vis-a-vis the days of warning. Is it my understanding that your answer to the question is that we would have days of warning as opposed to a "bolt out of the blue?"

General **Welch**. Yes, sir. I think that considering the day to day deterrent forces that we have, a "bolt out of the blue" in the absence of any crisis is truly an irrational act. And if we do not believe in rationality in peacetime, then the whole deterrent concept is wrong.

Senator **Exon**. General Welch, you have been asked a lot of questions today about strategy, what is going to happen, and what happens if the Russians do this, what happens if we reach some kind of agreement. Let me give you an iffy question along that line.

MOBILE MIRV SYSTEMS

If we were to ban mobile MIRV systems in agreement with the Soviet Union—and I am talking about, of course, the Rail Garrison MX here and the SS–24 over there—thereby obviously resulting in both sides having more vulnerable silo-based MIRV missiles, is that outcome advantageous to the United States, or would we then be moving back to instability?

General **Welch**. Well, I think there is general agreement that MIRVed silo-based missiles are a destabilizing factor. Driving MIRVed mobile missiles into MIRVed silo-based missiles I think has to be regarded as destabilizing. If you replace MIRV mobile missiles with un-MIRVed mobile missiles, that is fine, but that costs a lot of money.

Senator **Exon**. Does the Air Force understand exactly what went wrong during the first Small ICBM test flight? And when can we expect to see the second test flight?

General **Welch**. We understand where the failure was. It was in number two, second stage nozzle burnthrough. We do not yet understand exactly why that material failed, and so until we complete that analysis, we will hold the second flight.

I really cannot give you an estimate. I should not think that would be more than weeks.

Senator **Exon**. Then you are telling us that you are convinced it was not a design failure, but a failure in some of the key parts of the missile?

General **Welch**. No, sir.

Senator **Exon**. And the way they performed?

General **Welch**. No, sir. It was clearly a burnthrough in the second stage nozzle, which means either there is a burn pattern there that we did not understand, or there is a material problem there that we did not understand.

Senator **Exon**. I was listening with great interest to the comments that were made by Senator Warner regarding the B–2. I do think we need more information on this particular system.

I would point out once again that I think there is a general understanding—perhaps it is a misunderstanding—that the B–2 bomber is just another bomber. The facts of the matter are that the B–2 is a totally different system. Yes, it is a bomber; it is an airplane. And I think that when you start comparing the costs of that aircraft with other aircraft, it is not a fair comparison, because it is a totally new breakout system which would cause the Soviet planner more concern than anything else that I think we have ever done before. It would therefore, be a significant deterrent. And that is what we need to have established, in this Senator's opinion.

FIRST FLIGHT TIMEFRAME OF B–2

The other day I asked Secretary Atwood when he anticipated the first test flight of the B–2. He indicated in public testimony at that time that it would be in a matter of a couple of weeks. Do you concur with that timeframe, General?

General **Welch**. Well, I think it is within a month.

Senator **Exon**. Well, all right. There we go again.

General **Welch**. Close.

Senator **Exon**. I agree also with Senator Nunn, the system is in some difficulty up here. I think Senator Levin made the same point, as certainly did Senator Warner. We are intently waiting to make sure that that airplane does fly.

I think it will fly. I think it will do an outstanding job. I think you people in the Air Force are convinced that this is something that you need in the inventory. And we have got to do a better job, I think, than we have in explaining this not only to the public, but some of the Members of Congress who have not followed this system very well or are not as fully informed on it as I think they should be, particularly as to its possibilities and the breakout that this system would provide.

As an experienced Air Force officer would you agree that this is something more than just another bomber, and that this is a significant breakout or leap forward as far as deterrence is concerned.

General **Welch**. I certainly would. I would agree that it can do things over time that we do not know any other way to do, and it will do things immediately more efficiently and at a lower cost than any other way to do it.

Senator **Exon**. Gentlemen, that ends our round. You have been very patient.

Mr. Ambassador, Mr. Secretary, thank you for coming back again. General Welch, it is always good to have you.

Senator **Levin**. Could we keep the record open for additional questions?

Senator **Exon**. We will leave the record open for additional questions and ask you to respond as quickly as you can.

With that, we are adjourned.

[Questions for the record with answers supplied follow:]

Questions Submitted by Senator Carl Levin

BAN ON MOBILE MISSILES

Senator **Levin**. Mr. Wolfowitz, is the administration committed to proposing a ban on mobile MIRVed ICBMs, assuming we could effectively verify such a limitation?

Mr. **Wolfowitz**. No, but until we can assure ourselves that an effective verification regime can be devised for mobile ICBMs, permitting any mobile systems runs a great risk. At the same time, there is the added problem that while the U.S. has been deliberating over basing, the Soviets have developed, and are well into deploying, both a single-RV and a MIRVed mobile missile.

In order to have leverage on the Soviets to negotiate an effective verification scheme on mobile ICBMs, or should it prove to be in the U.S. interest to continue to pursue one or both mobile systems, the U.S. needs mobile ICBMs. The President's two-missile program, however, has not yet been funded much less deployed. A world, therefore, where the Soviets have mobile ICBMs and we do not is clearly the worst outcome, especially at the arms negotiating table. We need to have both mobile ICBMs (Peacekeeper Rail Garrison and Small ICBM) supported and fully funded by Congress.

THE PRIORITY OF ICBM MODERNIZATION

Senator **Levin**. In a March 1989 New York Times Op-Ed, your predecessor former Under Secretary of Defense for Policy, Fred Ikle, wrote, "In short, for the implausible risk of sudden, all-out nuclear attack in peacetime, other defense programs are more important than a new ICBM. And for the more plausible crises and wars, the new missiles would be useless." Do you agree with this assessment?

Mr. **Wolfowitz**. Fred Ikle also went on to say that, "If we were richer, it would be nice to have new missiles." I believe, however, it is important to note that in the March timeframe the program Fred Ikle was referring to was one that developed and deployed both the Peacekeeper Rail Garrison and the Small ICBM on a parallel track.

So yes, I agree with him, the Department does have other important budget priorities, and as a result we have recommended a two phase approach so we do not have the brunt of two ICBM development and production programs underway at the same time. The Small ICBM is now the second phase, delaying that program somewhat. The delay, however, will give us an opportunity to reduce the costs of this weapon system still further over and above the significant cost reductions we have made already. We believe that there is money to be saved in optimizing the system considering the factors of basing location, mobility and payload. The delay will also shift its funding profile into a timeframe where it will be more affordable.

ICBM MODERNIZATION

Senator **Levin**. General Welch, why are we building redundant mobile nuclear systems when we are cutting needed conventional systems such as the F-15E where it is proposed that we produce only one-half the number of F-15Es than was originally planned?

General **Welch**. Air Force programs in the President's budget were closely scrutinized to determine appropriate placement in overall funding priorities. Peacekeeper Rail Garrison and Small ICBM play a crucial role in ICBM modernization as complementary weapon systems designed to redress ICBM vulnerabilities and enhance ICBM capabilities against critical, high-value Soviet targets. Previously, funding both systems for near-simultaneous deployment was increasingly challenging in this era of constrained budgets. However, as reflected in the President's budget, sequencing the ICBM modernization program by redeploying Peacekeeper into Rail Garrison basing starting in 1992 and deferring Small ICBM initial operating capability until 1997 permits acquisition of both systems. Rail Garrison fills the near-term modernization need while Small ICBM adds significantly to long-term, flexible deterrence.

Senator **Levin**. Do you believe that we currently have robust nuclear deterrence?

General **Welch**. Yes, in light of the current threat.

Senator **Levin**. Without MXs on rail cars and without Midgetman, do you believe we will have robust nuclear deterrence through the 1990s?

General **Welch**. No. The Soviets already have a unilateral advantage in deploying mobile ICBM systems (the SS-24 and SS-25). Additionally, the hard target kill capability of the SS-18 will continue to improve throughout the 1990s. Continued modernization of our ICBM force, in concert with overall triad force modernization and improvements in command and control, is essential if we are to maintain our deterrent posture and enhance our capabilities in crises.

Senator **Levin**. If your answer to the previous question is other than an unqualified yes, what degradation of our present state of deterrence do you foresee in the 1990s?

General **Welch**. If we fail to move forward in completing triad modernization, U.S. ability to successfully deter aggression, in particular nuclear aggression, will slowly but surely erode in the face of continued Soviet improvements in capability. Said another way, the margin of risk in maintaining stability in crisis will gradually increase, particularly under likely arms control scenarios. Furthermore, as the Joint Chiefs of Staff have emphasized to the President, continued strategic force modernization is crucial to military sufficiency under START.

Senator **Levin**. What is the Air Force position regarding a total ban on MIRVed mobile ICBMs, assuming that the administration determined that a limit on mobile ICBMs was effectively verifiable?

General **Welch**. A total ban on MIRVed mobile ICBMs would be inconsistent with the U.S. objectives of enhancing stability. We seek to encourage the Soviets to move towards fewer MIRVed ICBMs in silos over time. With a MIRVed mobile ICBM ban, the Soviets could be expected to retain a large number of MIRVed silo-based ICBMs. Rather than a total ban on MIRVed mobile ICBMs, a sublimit on mobiles would permit a transition from silo-based MIRVed ICBMs toward mobiles in a way that caps the threat and permits the development of an effective verification regime.

Senator **Levin**. If the MX missiles were put on rail cars and we reached an agreement to ban mobile MIRVed ICBMs, would your preference be to return the MXs to their silos or to dismantle them?

General **Welch**. Return them to silos. We have a significant investment in a modernization deterrent system with the Peacekeeper. If mobile ICBMs were banned, returning the Peacekeeper to silos would retain high-quality warheads, thus preserving significant modernization expenditures and an essential prompt hard target kill capability.

Senator **Levin**. Would the fielding of a mobile Midgetman alone provide a sufficient level of ICBM survivability and stability?

General **Welch**. No. Fiscal realities and the lead time needed to develop and deploy the SICBM preclude it from being the sole solution in redressing ICBM vulnerabilities. Peacekeeper Rail Garrison is essential in the near-term to enhance crisis stability and along with Minuteman provide a timely and affordable foundation of weapons to cover critical, high-value targets.

Senator **Levin**. Since the Midgetman has been criticized in the United States as being too expensive one could assume that the Soviets incur an even higher cost to deploy their road-mobile ICBM, the SS-25. Do you think that the Soviets would be interested in banning all mobile missiles (including the road-mobile SS-25) in an attempt to save money?

General **Welch**. [Deleted.]

Senator **Levin**. In your opinion, is it more important to have two new mobile ICBMs or stronger conventional forces? Is it more important than buying the B-2?

General **Welch**. It is necessary that we field the forces required to deter an aggressor at any level of conflict. We continue to carefully review the projected threat and the trade-offs associated with deploying various levels of both conventional and strategic nuclear force capabilities. The President's budget has established the relative priorities between conventional and nuclear forces.

Buying two new mobile ICBMs and the B-2 are equally important to support the deterrent value of the triad, because of their different missions. The land-based, survivable ICBM provides a prompt retaliatory capability against time-sensitive, hardened targets. The B-2's role is to ensure our ability to penetrate enemy air defenses as well as provide the best hard target coverage due to its higher yield and better accuracy.

Senator **Levin**. How reliable are our Minuteman II and III missiles right now? How many more years of life do they have before they will need to be replaced?

General **Welch**. The current SIOP weapon system reliability planning factor for Minuteman II is [deleted] and Minuteman III is [deleted]. The next time Minuteman II is assessed the factor should decline based upon recent studies. Modifications/upgrades are programmed to return Minuteman II reliability to at least [deleted] and Minuteman III to [deleted].

Programs are ongoing or planned to replace portions of the Minuteman missiles as required due to age out. Projections show that Minuteman can be maintained to the year 2010 and probably longer, as long as modifications and replacements are made on time.

Senator **Levin**. What upgrades are currently envisaged for these missiles over the next 5-10 years? How much will these modifications cost?

General **Welch**. Over the next 5-10 years we expect to remanufacture all the motors that will age out in the Minuteman fleet. The Minuteman II guidance system computer will be replaced. The Minuteman III guidance system electronics, optics and computer will also be replaced.

In the launch facility we will provide improved Electromagnetic Pulse protection, improved emergency power and a new code change verifier. The Launch Control Center will be modified by the Rapid Execution and Combat Targeting (REACT) program. REACT will provide a new weapon system computer, dual position console, Rapid Message Processing and Rapid Retargeting.

Modification expenditures for the period fiscal years 1990-94 will average $400 million per year but for the period fiscal years 1995-00 will average $350 million per year.

Senator **Levin**. If the Midgetman missile is defeated in this Congress and the mobile MX is bargained away in Geneva, what ICBM would we choose to replace the aging Minuteman?

General **Welch**. We have begun to develop some technologies for an ICBM to follow the Small ICBM in the 2005-2010 timeframe. The Advanced Strategic Missile Systems (ASMS) program is working on guidance system technologies to be used on future ICBMs, or as a potential retrofit for Minuteman, Peacekeeper or Small ICBM after the turn of the century. Other efforts will begin as funds permit.

Even if Peacekeeper Rail Garrison and Small ICBM are deployed it is time to begin identifying the requirements for the next generation of ICBM, and we have begun to do so. Given the long lead times for development of a new ICBM, this planning is even more critical if our two mobile ICBM systems are not deployed. Experience with Peacekeeper and Small ICBM shows that about 16 years or more may be required to deploy a missile after development begins in earnest.

We plan to keep the Minuteman II and III missiles in our force structure well into the next century. This will be accomplished by a continuing program of repair, refurbishment and remanufacture to maintain existing capabilities and to upgrade systems when feasible and cost effective.

Senator LEVIN. One alternative to the two-missile compromise that has been suggested by the Center for National Policy is to produce small single-warhead ICBMs (like the Midgetman) and deploy them in existing Minuteman silos. In the short term such a decision will save us the cost of producing the very expensive Hardened Mobile Launcher (HML) for the Midgetman and it would provide Soviet planners considering a preemptive strike with an attractive, low value target. In the longer term, it provides the U.S. with a great deal of flexibility because if our SLBMs become vulnerable through Soviet advances in ASW these weapons could be taken out of their silos and placed in the HMLs, or put in another mobile basing mode.

Is DOD analyzing the possibility of deploying a silo-based Midgetman? If not, why not? Do you think that this type of plan has merit? Do you intend to study it in the future?

General WELCH. In December 1988, the Air Force conducted a comprehensive ICBM Modernization Program Review including Small ICBM alternatives. Two single RV Small ICBM alternatives were presented at that time; 500 missiles deployed in Minuteman silos, and 500 missiles deployed initially in Minuteman silos with future redeployment to Hard Mobile Launcher (HML) at Minuteman Launch Facilities. The acquisition cost to go for the silo only deployment was $4.5 billion (FY 88 $) less than the Baseline 500 Small ICBM in HML. HML production was less than $2.5 billion of this $4.5 billion savings. The cost savings ($4.5 billion) due to initial silo deployment is entirely erased and an additional $6.8 billion needed to redeploy in HML. Therefore, while in the short run the initial deployment to Minuteman silos would appear to save money, in the long run the total Small ICBM Program acquisition cost would increase by approximately 30 percent. Therefore, the Air Force has rejected the viability of this approach and does not intend to pursue it further.

QUESTIONS SUBMITTED BY SENATOR JOHN WARNER

SICBM BASING FUNDS

Senator WARNER. General Welch, will all of the $947 million added to the SICBM program go for basing, or will some funds be used on the missile as well?

General WELCH. Of the $947 million added to the Small ICBM program, 20 percent will go to missile integration, and the remaining 80 percent will be split equally between the Hard Mobile Launcher and Weapon Control Systems tasks.

SECURITY COSTS FOR SOUTHWEST BASING

Senator WARNER. As you have described the Southwest Basing option, Hardened Mobile Launchers will be constantly moving on the road network in peacetime. Will you have to add any special security forces to accompany the missiles?

General WELCH. Yes, security forces will accompany or be in proximity to respond to the Hardened Mobile Launchers. These security arrangements will be like those for other mobile nuclear weapon systems that the United States has deployed.

QUESTIONS SUBMITTED BY SENATOR MALCOLM WALLOP

ICBM MODERNIZATION

Senator WALLOP. I understand your budget request includes funds for a number of extra reentry sets beyond those needed for the fifty missiles on alert. Because this request might be misunderstood to mean that the Air Force wants to have more than the 50 MX on alert that Congress has authorized, will you explain the purpose of these extra reentry sets?

General WELCH. The fiscal year 1990 budget includes $80 million to buy five additional reentry systems to facilitate the redeployment of Peacekeeper missiles from silos to Rail Garrison basing. Initiation of rebasing will require assembly of five production/test missiles at the Missile Assembly Building and transport to a Rail Garrison base. There the canisterized production test/missiles will be mated with the additional reentry system sets and made available for alert. After completed missiles are deployed, an equivalent number of silo-based Peacekeeper missiles will be removed from alert and taken from the silos, disassembled and prepared for rebasing to Rail Garrison through the same method described above. In this way, throughout the redeployment process, Strategic Air Command will always have a miminum of 50 missiles available to cover its SIOP target assignments.

Also, the maintenance concept for Peacekeeper Rail Garrison requires a total of five spare reentry systems: three full-up systems in storage at F.E. Warren AFB for dispatch and two in transit/maintenance. Presently Peacekeeper in Minuteman silos only has two spare reentry systems. Upon completion of redeployment the additional assets will support the increased spares requirement for Rail Garrison deployment.

Senator WALLOP. The Air Force has requested $99 million in R&D funds for the Advanced Strategic Missile Systems program. This is down from $129 million in fiscal year 1988 and $141 million in fiscal year 1989. I understand that alternative guidance systems and earth penetrating reentry vehicles have become your highest priority in this program. Doesn't this just about eliminate any research in penetration aids for the SICBM?

General WELCH. No. The development of pen aids technology will continue in fiscal year 1990 as the highest priority technology development. We are maintaining a technology exploration effort in pen aids that will provide options against full-spectrum frequency discrimination. We will emphasize pyrotechnics as a means of countering optical discrimination, and simulation in the radar frequency domain. This technology would be applicable to the Small ICBM, Peacekeeper or Minuteman III missiles. We plan to flight test some of the technologies in fiscal year 1991.

Senator WALLOP. As the MX/Peacekeeper has been introduced into the Strategic Air Command, has the missile met your standards for alert status, or have any missiles had to be taken off alert because of problems?

General WELCH. [Deleted.]

Senator WALLOP. Last time you appeared before the committee, I asked you about what I believe to be an alarming trend in the strategic force budget: the disproportionate share going to the bomber force. You will recall, I pointed out that over 40 percent of the next strategic force FYDP will go to bombers with only about 10 percent for ICBMs. You answered by saying that bombers were a good value. Without disputing that, let me come at the question from a different angle: can we expect to maintain the efficacy of the ICBM force, in your judgment, beyond this FYDP and the next one after that, if the ICBM force continues to get only about 10 percent of the strategic force budget?

General WELCH. Yes. The President's program for ICBM modernization (i.e., Peacekeeper Rail Garrison and Small ICBM) coupled with continued relations on Minuteman will maintain required ICBM capabilities. The program also reflects the historical ICBM strength of low operating and supportability costs relative to other portions of the triad.

QUESTION SUBMITTED BY SENATOR SLADE GORTON

SMALL MISSILE DEVELOPMENT

Senator GORTON. It is my understanding that the Small Missile was built to be compatible with a mobile basing mode. In other words, there is no requirement for a Small Missile if there is no mobile basing mode. Why then are we putting all our emphasis on the missile and not putting some on the survivable basing mode?

Mr. WOLFOWITZ. The Small ICBM was designed specifically for mobility, including the development of a hardened mobile launcher (HML). The concept of mobility for this missile has not been abandoned in the President's two phase missile modernization program; it will be a road-mobile missile. The reason for the emphasis on just the missile portion of the program at this point in its development is to allow us time to optimize the mobility of this missile with basing location and payload options to further reduce the costs of this Small Missile program. Until these decisions are made, it would not be productive to pursue further development of the HML and other basing related tasks.

[Whereupon, at 12:04 p.m., the committee was adjourned.]

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